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PAPER TRADE JOURNAL

FEBRUARY 3, 1944

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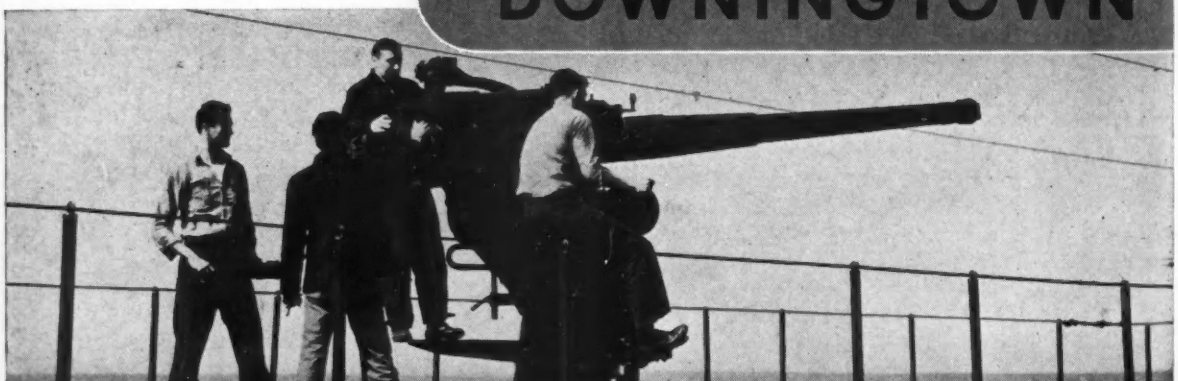
DOWNINGTOWN



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We're "Backing the Attack" of the LANDING CRAFT

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PAPER TRADE JOURNAL
Title Reg. U. S. Pat. Off.

Vol. 118, No. 5 Thursday, February 3, 1944 Price Ten Cents

Pulp and Paper Men Meet at Montreal

More Than 500 Delegates Hold Highly Successful Convention—Numerous Technological And Business Problems Are Discussed By Experts In Their Field—Sections Hold Many Interesting Meetings.

[FROM OUR REGULAR CORRESPONDENT]

MONTREAL, Que., January 29, 1944—The annual three-day convention of the Canadian Pulp and Paper Association, which concluded here yesterday, was again highly successful, more than 500 delegates attending. The whole three days were given up almost completely to intensive studies of technological and business problems on which many able experts read papers, and in regard to some of which there were interesting discussions. The first two days were devoted to meetings under the auspices of the Technical Section and the Woodlands Section, both of which have large memberships embracing the leading authorities in their respective spheres in the industry in Canada.

President's Address

E. Howard Smith, of Montreal, in his address as president of the Association, said that the Pulp and Paper industry was in one respect in a favorable condition to meet after-war problems because, unlike many of the industries, it had been operating throughout the war with the same machinery and equipment as previously and would not have to face a period of readjustment and revamping of machinery. He warned, however, that with the end of the war the industry would still have to face competition. "This may not be as serious as after the first World War but as Europe gets back on her feet the competition will increase and it will be up to us to meet it."

He said that to do this successfully one of the first requirements would be an adequate supply of pulpwood at costs which would enable the industry to meet competition.

He added that the mills cannot continue to make pulp and paper unless they can produce in competition with the rest of the world. "Therefore we must look to the men in charge of forest operations not only to deliver the wood to the mills but to deliver at the lowest possible cost and in the most efficient manner."

Sees Possibility of Quadrupling Output

Speaking before the Technical Section on "The Future of the Pulp and Paper Industry," E. M. Little, general manager of the Anglo-Canadian Pulp and Paper Mills, set forth as a possible objective an output of pulp and paper from Canada's forests of four times the present rate, this being dependent on technological progress commensurate with the opportunities offered. In connection with the latter, he said "Some of the less fortunate peoples of the world would give their eye teeth for the opportunities which we in this industry possess."

Careful investigation, he said, indicated that Canada had about 430,000 square miles of productive forests that were considered accessible and an additional amount considered economically inaccessible that would bring the total to 770,000 square miles of accessible and inaccessible productive forests. In southern Europe, where soil and growing conditions were not superior to Canada's, an annual growth of 28 cubic feet per acre had been achieved as compared with 14 cubic feet per acre in Canada. Therefore if by proper forestry practice Canada could achieve an annual rate of growth equal to that in Northern Europe the amount of wood available to the forest industries of Canada would be doubled. He believed it possible by improved logging methods and by proper location of future mills to make economically inaccessible timber accessible, and thereby the size of the industry could be trebled. And further if they could completely eliminate waste through fire, pests, etc., the size of Canada's forest using industries could be quadrupled.

The present practical productive capacity of the pulp and paper industry was approximately 5,000,000 tons a year, but developments such as he had outlined would provide for a pulp and paper industry of 20,000,000 tons a year.

As to markets for such an output, he said the extra 15,000,000 tons a year was insignificant in relation to the possibilities of world demand. Looking to the progress of people everywhere under the new conditions opening up, he believed that countries with a combined population of 1,750,000,000 people would in time consume pulp and paper products at the same per capita rate as prevailed in the U. S. A. in 1936, which would mean that the world market for

(Continued on page 23)

Wisconsin Paper Group Elects Officers

A. J. Schierl Heads Organization and Other Officials Are Elected at Annual Meeting — Mill Employment Off Fractionally — Safety Council Opens Series of Meetings—Other Industrial News.

[FROM OUR REGULAR CORRESPONDENT]

APPLETON, Wis., January 31, 1944—A. J. Schierl, secretary and assistant manager of the Whiting-Plover Paper Company, Stevens Point, was elected president of the Wisconsin Paper Group at its annual meeting at Valley Inn, Neenah, Saturday afternoon, January 22. Fifty-seven executives of the 31 member mills were present.

Mr. Schierl succeeds Elmer H. Jennings, vice-president and sales manager of the Thilmany Pulp and Paper Company, Kaukauna, who automatically remains a member of the executive committee for the ensuing year. The former vacates the vice-presidency, to which Roy H. Purdy, general manager of the Tuttle Press Company, Appleton, was elected. Leo Schubart, secretary-treasurer of the Neenah Paper Company, Neenah, was reelected secretary-treasurer, and Irwin Pearson, Menasha, executive secretary. Mr. Pearson has held the office for ten years since the Group was started.

Two additions were made to the executive committee, W. L. Thornton, manager of transportation for Kimberly-Clark Corporation, Neenah, and R. J. Sund, director of manufacturing for the Menasha Products division of the Marathon Paper Mills Company, Menasha. Remaining members of the executive committee who were reelected are: J. D. Young, Edgewater Paper Company, Menasha; A. C. Remley, general sales manager of Nekoosa-Edwards Paper Company, Port Edwards; G. T. Keappock, purchasing agent of Nicolet Paper Company, De Pere; F. C. Heinritz, secretary of Appleton Coated Paper Company, Appleton, and Norman S. Stone, secretary and general manager of the Mosiness Paper Mills Company, Mosinee, Wis.

The non-profit scheduled pool car freight delivery to customers, which is the function of the group, was maintained at about its usual level, and during the last year was a factor in conserving transportation under wartime conditions. The report of Mr. Pearson showed that arrangements had been made for the movement of 2,915 pool cars of paper and paper products of Wisconsin mills to 329 cities throughout the United States.

Following the business session, the executives heard an address by Colonel Dan A. Hardt, zone transportation officer for the Army Service Forces at Chicago. He formerly was associated with the sales department of the Neenah Paper Company. He described the Herculean task involved in maintaining and supplying the greatest armed force in the history of the United States, emphasizing the slogan, "Enough and on time!"

Mill Employment Down Fractionally

December employment in Wisconsin paper and pulp mills and allied industries showed a tapering off of 0.9%, dropping from 23,200 workers in November to 23,000, and 1.1% below December of 1942, when there were 23,300 on the payrolls, according to compilations by the Industrial Commission of Wisconsin. Payrolls took a dip of 0.5%, going from an average of $887,000 per week to $872,000, but still up 5.1% from December a year ago when the average was $826,000. The hourly rate averaged 82.7 for December, the weekly pay check $37.64, and the number of hours worked 45.5 per week.

Twenty plants in the Milwaukee metropolitan area reported 2,114 employed during December, a drop of 0.4% from November. Payrolls averaging $77,107 per week were 3.3% below November. An average hourly rate of 81.5 cents brought $36.47 per week for an average of 44.8 hours.

Will Meet to Discuss Water Tolls

Wisconsin River water power tolls to be assessed against users, amounting to about $117,000 for the last six months of 1943, will be the subject of a hearing conducted by the Wisconsin Public Service Commission at Madison, Wis., February 4. They are assessed by the Wisconsin Valley Improvement Company, and are sufficient to pay a net return of 7% on the investment.

Among the assessments are: Rhinelander Paper Company, Rhinelander, $1,991; Tomahawk Kraft Paper Company, Tomahawk, $3,114; Tomahawk Pulp Company, Tomahawk, $1,591; Marathon Paper Mills Company, Rothschild, $3,315; Mosiness Paper Mills Company, Mosinee, $2,763; Consolidated Water Power and Paper Company, DuBay dam, $8,437, Stevens Point dam, $5,740, Biron dam $8,236, and Wisconsin Rapids dam, $10,826.

Wisconsin River Paper and Pulp Company, Stevens Point, will be assessed $7,289; Whiting-Plover Paper Company, Stevens Point, $169; Nekoosa-Edwards Paper Company, Centralia dam, $4,661, Nekoosa dam, $7,245 and Port Edwards dam, $4,152.

Safety Council Opens Meetings

Monthly dinners are being held by the Twin City Safety Council of Neenah and Menasha, Wis., to discuss safety education and problems. At the first of these, January 26, at Hotel Menasha, Menasha, slide films on foremanship training were shown. Howard H. Aderhold of the Marathon Paper Mills Company, Menasha, and E. A. Page of Kimberly-Clark Corporation, Neenah, were in charge.

Credit Union Buys War Bonds

The credit union of Kimberly-Clark Corporation's Lakeview mill at Neenah, Wis. voted last week to invest $10,000 in war bonds. Officers were elected as follows: President, R. H. Corey; vice-president Howard Ruth; secretary, Robert Wood; treasurer, Doris Schmidt; assistant secretary-treasurer, Shirley Page.

J. P. Reeve Honored

John P. Reeve, personnel manager of Appleton Coated Paper Company, Appleton, Wis., was awarded

the distinguished service key of the United States Junior Chamber of Commerce at a banquet January 24. It is given each year to the most outstanding young man of Appleton from the standpoint of community service. The presentation was made by Mayor John Goodland, Jr.

Rex Hovey Reports on Production

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., February 2, 1944—The manfacture of the recommended minimum production of paper and paper board, totaling 1,398,837 tons per month during the first quarter of 1944, is now under way, made possible through the allocation of 864,811 tons of pulp to United States mills each month, Rex. W. Hovey, director of the War Production Board Paper Division, said today. Practically all mills are in operation, he added, despite lack of normal supplies and labor and other handicaps.

The recommended paper and paperboard monthly production is 7.3 per cent over the average monthly production in the fourth quarter of 1942; 3.8 per cent under production in October, 1943, and 8 per cent below the production originally proposed by the industry, which indicated it could deliver 1,520,518 tons per month, Mr. Hovey, as Government presiding officer, told the Over-all Paper Industry Advisory Committee at its session here.

The Over-all paper Industry Advisory Committee, composed of eighteen representative paper manufacturers, was presented statistical and analytical data on pulpwood, pulp, waste fibre, paper and paperboard, released for the first time by the Department of Commerce and Mr. Hovey gave a report on trends and developments in both the pulp and paper industries, as they are related to the present shortages.

"From now on," he said, "the Bureau of Foreign and Domestic Commerce, of the Department of Commerce, in cooperation with the Forest Products Bureau of the WPB, will keep the industry informed each month as pertinent information becomes available."

The attached table summarizes average monthly past and proposed production of paper and paperboard, and shows the amount of pulp allocated to the several segments of the industry to produce the minimum tonnage of paper and paperboard required by the WPB Requirements Committee.

AVERAGE MONTHLY PAPER AND PAPERBOARD PRODUCTION AND ALLOCATION IN TONS

	Paper and Paperboard Production per Month				WPB Authorized Consumption of Pulp
Grades	4th Quarter, 1942	October, 1943	Industry's Proposed 1st Quarter, 1944	WPB Recommended Minimum 1st Quarter, 1944	1st Quarter, 1944
TOTAL	1,303,761	1,454,423	1,520,518	1,398,837	864,811
PAPER					
Newsprint	78,696	65,336	70,356	60,000	62,233
Groundwood ..	49,518	50,154	56,689	44,784	45,232
Book	148,875	135,107	145,273	114,732	78,707
Fine	88,372	85,370	93,896	74,178	62,755
Coarse	160,624	163,574	178,737	157,190	155,618
Multiwall	17,693	31,796	33,350	29,000	30,247
Spec. Ind.....	17,020	16,524	23,430	21,770	18,884
Sanitary	65,156	68,303	72,676	66,433	65,437
Tissue	11,496	13,974	15,390	13,428	13,334
Absorbent	5,769	7,647	7,134	7,616	4,973
Building Papers	81,795	79,469	77,137	77,137	15,247
PAPERBOARD					
Container	293,714	360,252	363,447	363,447	199,096
Folding	127,658	172,221	181,683	167,801	40,104
Setup	71,821	63,565	63,016	63,016	592
Cardboard	...	5,852	4,438	4,438	1,741
Building	49,272	87,334	76,585	76,585	55,526
Other	29,282	48,125	57,281	57,281	15,085

17,036,273 Tons Produced

The Forest Products Bureau of the War Production Board has just reported that 1,360,635 tons of all varieties of paper were produced during December of 1943. This added to the figures reported previously by the War Production Board gives a total of 17,036,273 tons for the entire year. The monthly production of paper and paperboard by type is given below for November and December:

MONTHLY PRODUCTION OF PAPER AND PAPERBOARD, BY TYPE, NOVEMBER-DECEMBER, 1943[1]

(Tons of 2,000 pounds)

Types of paper	November	December[2]
All types[3]	1,422,475	1,360,635
Newsprint	65,833	63,962
Groundwood papers	50,613	48,991
Printing	11,636	11,706
Specialties	38,977	37,285
Book papers	131,868	126,427
General printing	79,844	75,862
Converting papers	34,719	33,966
Other book papers	17,305	16,599
Fine papers	84,107	77,356
Writing papers	58,157	51,923
Drawing, cover, text	4,954	4,500
Reproduction papers	8,297	8,737
Bristols	7,557	7,399
Thin papers	4,478	4,311
Other fine papers	664	486
Wrapping papers	196,530	189,137
Bag papers	38,955	38,161
Multi-wall heavy duty sack	31,472	29,686
Wrapping	28,278	23,340
Glassine	6,916	6,845
Greaseproof	2,077	2,460
Vegetable parchment	2,904	2,648
Converting papers	34,831	36,358
Other wrapping papers	51,097	49,639
Special industrial	16,301	15,066
Sanitary papers	65,542	62,487
Tissue papers	13,260	12,368
Absorbent papers	7,395	8,214
Building papers	75,010	71,214
Paperboard	716,015	685,407
Container board	349,337	331,061
Tube stock	29,704	29,622
Folding boxboard	163,703	156,925
Set-up boxboard	61,644	61,459
Cardboard	5,977	5,446
Building board	86,029	81,704
Other	19,621	19,190

[1]Data cover all known mills, and represent a continuation of the monthly statistics initiated in "Facts for Industry," Series 24-2-1. For annual data prior to 1943, and a description of the statistics, see "Facts for Industry," Series 24-1-1. Refer all inquiries concerning these data to: Bureau of the Census, Washington 25, D. C.
[2]Includes a small quantity of paper not classified by type.
[3]Preliminary.

OPA Reports Paper Decisions

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., January 26, 1944—"Novel news" or "novel paper", averaging over .004 inch thick per sheet and used in "pulp" magazines is a "groundwood specialty paper" within the meaning of Regulation No. 449 and therefore is covered by it; it is not "newsprint" under Regulation No. 130 (newsprint paper), says OPA in an informal decision.

OPA has also ruled in another informal decision that kraft wrapping papers, whether colored or not, are covered by Regulation No. 182 if sold at the manufacturer's and distributor's levels. All other wrapping papers are covered by Regulation No. 129.

In a third decision OPA states that "No. 1 news" of the highest quality consists of 100½ waste newspapers, entirely free of objectionable papers and foreign materials. Lower qualities of this grade may sell at the maximum price listed in Section 1347.14 only if they meet the minimum specifications of the grade, i.e. the packing is sufficiently free from objectionable papers, foreign materials and fibers other than newspaper, to form a commercially acceptable delivery by the customary standards of the trade.

Chicago Reports Strong Demand in All Lines

Waste Paper Drive Increasing Supply of Paper Stock—Milk Carton Battle Reaches Climax—Ed. M. Brower Forms Jobbing Concern — New "Professional Paper" Group is Formed — Other News.

[FROM OUR REGULAR CORRESPONDENT]

CHICAGO, Ill., January 31, 1944—Increases in the light weights of kraft wrapping papers as granted by the OPA, ranging from 5 cents to $1 per hundred weight, are taken in Chicago to mean that forces within the WPB who realize that price control can retard production, have convinced OPA of the idea that the philosophy of scarcity can be overdone. Production of these weights of krafts has fallen off in recent months, according to local paper dealers. A part of the reason, though there are other major reasons such as pulp and manpower, is recognized as due to the inability of producers to get a ceiling profitable enough for them to operate.

Whether or not the attempt to harness price and production in a realization that production and production alone is the best answer to inflation, black markets and far flung economic disturbances, will become the dominating policy of OPA-WPB is a topic of conversation here where the market conditions are rapidly growing worse. Demand continues strong and groundwood, newsprint, book, cover, wrapping and all grades are simply marking time as forces try to apply action to the manpower, chemical and pulp problems. Waste paper collections, with the salvage drive as a motivating force, and with splendid collection weather available, brought in plenty of tonnage and is helping to brighten things up around here materially.

Carton Fight Reaches Climax

To a paper industry which may be somewhat bewildered over Chicago's action in relation to paper milk bottles the following taken from "Heard and Seen," a wisely edited information bulletin on political and civic matters, may be interesting, "The Chicago Daily News is right in urging an ordinance legalizing the sale of milk in Chicago in cartons. It was the Corporation Counsel who sought to prevent the sale of milk in paper containers. He fought the cartons up to the Supreme Court of the State. A majority opinion sided with him holding that, as the ordinance said 'bottles' that meant a glass container. A minority of the court held that a bottle could be of leather or paper as well as glass. The time of our courts shouldn't be taken up with such a matter. The fight on paper containers undoubtedly was a political one as the glass bottle bunch, it is said, made substantial campaign contributions. On the other hand the carton crowd were in politics, too. Public interest was lost sight of. The cartons were approved by the city's health department long ago. Their worth and their economy have been demonstrated in extensive use. Only city hall politics stood against them. Operating under an injunction to restrain the city authorities from interfering with them, the companies using cartons have long been serving much of Chicago's trade. To bar them now, because of a hair-splitting court decision, would be to cause a milk shortage—as there is a shortage of glass bottles. The council should legalize paper containers." The press—and a straw vote among council members indicates that this will be done and Chicago's "sham battle" brought to an end.

Begin New Jobbing Firm

Edward M. Brower, a veteran of twenty-five years' experience in the Chicago paper industry, has recently created the Active Paper Company which will engage in the jobbing of wrapping papers and general sundry supplies. The offices of the company will be at 605 N. Michigan avenue while warehouse facilities will be provided elsewhere to service customers. Mr. Brower was, for the past ten years, affiliated with the Brower Paper Company which he now leaves to set up his own organization. Prior to that time he had been identified with the Whitaker Paper Company and with the Humbolt Paper Company.

New "Pro" Group Formed

A "professional paper" group, technical men whose job it is to develop the best production and use of paper, was organized into a formal group this month, the organization to be known as the Chicago Professional Paper Group. H. R. Alley, technical director of Tested Papers of America, Inc., is the president of the new organization. The vice president is A. E. Montgomery of the Ross Engineering Company and V. V. Vallandighan of the Kelco Company is the treasurer. Arnold McAneny, technical research director of Bradner Smith & Company, will serve as treasurer. Technical men interested in the manufacture, conversion and printing steps in the industry are reported to be eligible to join the organization which is expected to become a division or unit of TAPPI itself. Monthly meetings are planning at which time war problems, food packaging and postwar plans will be discussed.

To Manage Distributor Sales

Fred A. Conkle is now manager of the distributor sales department of Wyandotte Chemicals Corporation—both J. B. Ford and Michigan Alkali Divisions. Since 1940 Mr. Conkle has been sales manager and then general manager of the William Lynn Chemical Company, Inc., of Indianapolis, Ind. This company is a distributor for products of Wyandotte Chemicals Corporation.

Distributing and jobbing problems are a rightful inheritance with Mr. Conkle as his father owned and operated a wholesale grocery firm for more than 40 years. Mr. Conkle was a battery sergeant in the Rainbow Division in World War I. He has sold road and materials handling machinery, and before joining Lynn Chemical he was sales manager for a rock asphalt firm. He has many friends among both chemical manufacturers and distributors. Mr. Conkle's office will be in Wyandotte, but he will spend a considerable part of his time with the more than 800 Wyandotte distributors.

Instrumentation Studies. XLVI*

Tearing Strength of Paper

By the Staff of The Institute of Paper Chemistry

Abstract

Elmendorf's method of testing paper for tearing strength satisfied a long-felt need in a very simple and effective manner. However, since the advent of this satisfactory method for measuring tearing strength, much data on this property have been obtained which are not well understood. Many practical facts regarding the behavior of tearing strength are known, such as: the negative correlation between tear and tensile or burst; the usefulness of tear in controlling beating and other refining, as regards cutting, when considered in conjunction with tensile or bursting strength; similarly, the usefulness of tear in comparing different types of beating actions.

Very little work appears in the literature on the theory of tearing strength. If a theory is to be useful and comprehensive, it must account for such facts as: the variation of tearing strength with degree of beating (slight initial rise to a narrow maximum followed by a decline); the dependence of tearing strength on fiber length (positive correlation); the increase in tearing strength accompanying a decrease in bonding strength brought about through the use of material added to the furnish, and the inverse effect.

A new theory is presented, by means of which a careful analysis is made of the manner in which the energy expended in tearing a sheet is dissipated in the paper. When a sheet is torn, m *fibers are ruptured in tensile failure and* n *fibers are pulled intact from the mesh of contiguous fibers. The average* work *required to break a fiber is ordinarily insignificant in comparison with the work required to pull a fiber intact from the mesh, the* force *involved in the latter case being somewhat less. Since the average tearing force is equal to the sum of these two works divided by twice the length of line of tear, discussion of tearing phenomena with theory reduces to consideration of the effects of various treatments and pulp properties on* (a) *the relative numbers of fibers ruptured in tension and pulled intact from the fiber mesh, and* (b) *the average work required to pull a fiber from the mesh.*

The initial rise in the tearing strength-beating time curve is due to the fact that, in the initial stages of beating, the "frictional drag work" increases by virtue of tighter enmeshment caused by slightly increased bonding, during which time only a negligible number of fibers fail in tensile rupture. As the beating continues, however, more fibers fail in tensile rupture and, therefore, fewer fibers are pulled intact from the mesh. Since the frictional drag work per fiber is very much greater than the rupture work, this decrease in the number of fibers pulled intact from the mesh causes the tearing strength to decrease. Similarly, the addition of a material which reduces bonding strength will increase the tearing strength by increasing the number of fibers pulled intact from the sheet, and it is frequently observed that the addition of a bonding agent will cause a decrease in tearing strength. The positive correlation between tearing strength and fiber length is due to the fact that the frictional drag work depends directly on the average fiber length, being theoretically proportional to this length.

The Elmendorf-Thwing instrument is based on a uniquely simple, straightforward, and intrinsically accurate method. Excepting certain obvious maladjustments which could be noted by any observant operator, this instrument should remain in accurate calibration after having been carefully checked and calibrated. A theoretical error arising in the manner of allowing for friction in the pointer mechanism and bearing has been studied, and it is shown that this is of no real significance, provided, of course, that the pointer stop adjustment is properly made. An error due to multiplicity of specimens simultaneously tested is briefly described.

A little more than two decades have elapsed since Elmendorf *(1)* published the first of a number of papers by himself and others descriptive of the Elmendorf method of measuring tearing strength *(2-10)*. Manual tearing in the hands of experienced, expert papermakers had been considered a guide of paramount importance in the judgment of quality of paper, and hence many attempts had been made to devise apparatus which would enable a measurement of the force required to tear a sheet. The strong variability of the force during the tearing, however, had caused the data to be inaccurate and, although useful information was obtained from direct measurement of the tearing force, there was a strong need for an instrument which would automatically average the force. The Elmendorf apparatus fills this need in an elegantly simple manner. As is well known, the erratic tearing force is averaged through measurement of the energy expended in producing a tear through a given distance.

Shortly after the Elmendorf method was made available to the industry *(2)*, various workers found that tearing strength does not correlate with other strength tests. Perhaps the best known and most commonly observed behavior of tearing strength is that exhibited by paper from a pulp beaten to different degrees. Following an initial rise to a narrow maximum, the tearing strength decreases with increasing degree of beating. Since the decline in tearing strength accompanies a shortening of fiber length, many papermakers have regarded the tearing strength test as a measure of the degree of cutting of fibers in the beater or other refining mechanism. While there is certainly a real connection between tearing strength and fiber length, it is generally appreciated that other factors should be considered in conjunction with tearing strength in any appraisal of the relative degrees of cutting and fibrillating actions.

In view of the obscure nature of the significance of tearing strength, the industry has requested that the subject be discussed in the Instrumentation Program. In this report, significance of the test as discussed in the published literature is treated first. Following this, there is a discussion of the meaning of tearing strength from the theoretical viewpoint, and the report concludes with remarks on instrumental errors.

* This report is one of a series issued as a part of the instrumentation program of The American Paper and Pulp Association.

February 3, 1944

Significance of Tearing Strength

Practical Aspects

When paper is subjectively tested by tearing in the hands, an attempt is made to judge the quality of the sheet, with particular reference to toughness. In the same sense, the modern tearing test is performed as a check on the quality of the finished paper and for the purpose of controlling the papermaking process *(11-15)*. Except for its possible direct application to tissue papers, tearing strength is not of direct usefulness in the ordinary actual applications of paper. It is the opinion of a number of persons that tensile strength and bursting strength are more directly related to "use requirements." However, the tearing strength taken with tensile or bursting strength enables one to readily control the degree of cutting. For a given pulp and grade of paper, the tearing and bursting strengths will have certain values; if the tearing strength is high and the bursting strength low, it is probable that the furnish had not been subjected to sufficient beating action and, conversely, low tear and high burst are a combination associated with a degree of beating greater than normal. However, if the tearing strength is disproportionately low (in consideration of a given increment in bursting strength), it is probable that cutting in the beaters or jordans is above normal.

Different methods of beating a given pulp may effectively be compared by studying the relative effects upon the tearing strength. For example, Nagl *(11)* showed that two stocks beaten from the same pulp with different beaters had quite different tearing strengths. When beaten to the same freeness, stock treated with a stone roll had a tearing strength 70 per cent greater than that of stock beaten with iron tackle.

In like manner different pulps may be compared with the help of the tearing test. Two pulps may have similar strength development curves, yet have quite different tearing strengths. As a general rule the pulp having the longer fibers will possess the greater tearing strength, although factors other than fiber length influence the tearing strength, and this rule, like others mentioned here, often will not be followed.

Although brittleness is best measured by means of the folding endurance test, the tearing strength is profoundly influenced by any action which causes an embrittlement of the paper. Without doubt the strength and extensibility of the fibers and the strength of bond between the fibers in the sheet of paper, have important influence on the tearing strength.

There is apparently little connection between tearing strength and "initial tearing strength." Whereas the former is the average force required to sustain a continuing tear, the latter is the moment of force, under given conditions, required to start a tear in the edge of a paper sheet. Recent work *(16)* indicates that initial tearing strength depends upon tensile strength and stretch.

In studies involving unusual conditions, the tearing strength often exhibits a behavior which is difficult to account for, and there have undoubtedly been many occasions when an adequate theory of tearing strength would have been very useful as an aid to thinking and discussion. Accordingly, a theoretical discussion has been prepared for this report.

Theory

The literature contains very little on the theory of tearing strength. The only detailed account of an attempt to develop a theory is that of Brecht and Imset *(17)*. These authors regard the zone of tearing as extensive, not as a point. In this zone the elemental forces involved in the tearing stress give rise to a moment of force with respect to a point of reference; the tearing force is then obtained by dividing the moment by the perpendicular distance from the reference point to the line of action of the tearing force. The theoretical picture is qualitative in the sense that few of the quantities involved can be evaluated. The virtue of the picture is that it shows how extensibility and fiber length influence the size of the tearing zone and, therefore, also the tearing strength. The Brecht-Imset theory emphasizes the influence on tearing strength of stress concentration in the zone of tearing. Clark *(12)* has briefly discussed this aspect of the theory of tearing.

The weakness of the Brecht-Imset theory is that it attempts to deal with the forces between fibers during the tear. The theory tacitly assumes a uniform distribution of steady forces over the zone of tear. Actually, the individual forces between particular fibers and other fibers vary in a most nonuniform manner. A time chart of the force between a certain fiber and contiguous fibers would be represented by a curve which runs along the time axis, at zero, until that fiber becomes involved in the tear, when the curve rises suddenly to a maximum, then falls off again to run along the time axis. Any theory, then, which involves directly the forces making up the tearing force must ultimately incorporate a summation of all the forces, whose variation with time is of the sort described above.

An analysis of this problem and consideration of the intrinsic difficulty of dealing directly with the forces to arrive at an average tearing force have led to the development of a theory which has, since its origin, proved useful *(18)*.

In his consideration of the difficulty of obtaining an accurate measure of tearing force, which varies erratically from point to point in the sheet, Elmendorf developed a method which yields an average of the *total* force through a measurement of the energy required to tear the sheet through a given distance. The new theory properly regards the *total* force as being itself the sum of a large number of forces which vary erratically on a *microscopic* scale, as previously described. Even though the total force were constant from point to point in the sheet, one would still be confronted with this erratic variation of force on a microscopic scale, wherever paper or other fibrous sheet material is torn. In the attack on this problem, we start, as in the evaluation by the instrumental method, with the fact that the work put into the process of tearing is $2Fe$, where F is the total tearing force and e is the length of the segment to be torn. The main portion of the remainder of the theory consists of an analysis of the mechanisms by which this energy is dissipated. It is this analysis which is useful in explaining the behavior of tearing strength.

Before presenting the theory, it would be well to consider briefly some of the phenomena to be accounted for. The well-known variations of bursting strength, freeness, and tear with beating time are

presented graphically in Fig. 1. As the bursting strength increases, the tearing strength decreases. Often the tearing strength curve will exhibit a rise in the neighborhood of zero beating time, followed by a narrow maximum and the declining curve shown in Fig. 1. The presence or absence of the maximum depends upon the nature of the pulp and the amount of mechanical action to which the stock had been subjected prior to beating. Dixson *(19)* has established the interesting curves for bursting strength and tear given in Fig. 2.

The energy expended in tearing is transformed mainly into two processes: *(a)* stretching individual fibers until they break in tensile failure, and *(b)* pulling individual fibers out of the mesh of fibers. In the latter process the energy expended is that required to overcome the frictional drag exerted by contiguous fibers.

Let us call the work required to break an individual fiber (in tension) w_r, the subscript r denoting rupture. The work required to drag a fiber out of the mesh of contiguous fibers we may designate as w_r, the subscript f denoting friction. If, in the process of tearing, m fibers are ruptured under tensile stress, and n are pulled from the mesh intact, the total work done in tearing is (mw_r+nw_t). It has been pointed out above that the total work going into the process of tearing is $2Fe$, where F is the observed tearing force, and e is the length of line of tear. Equating these two energies, we have

$$F = (mw_r + nw_t)/2e \qquad (1)$$

According to Equation 1 the tearing strength will depend upon the average value of the work required to rupture a fiber, w_r, the average work required to drag a fiber from the mesh, w_t, and, of the total number of fibers involved in the tear $(m + n)$, the number involved in rupture *(m)* and the number dragged intact from the fiber mesh *(n)*.

Paradoxically, the work required to rupture a fiber may, under ordinary circumstances, be *very much less* than the energy required to drag a fiber, unbroken, from the mesh. In other words, if some treatment of the pulp or of the finished sheet causes m to increase (and n thereby to decrease), the tearing force F must decrease. This statement applies for ordinary conditions; deviations from this rule will be discussed later.

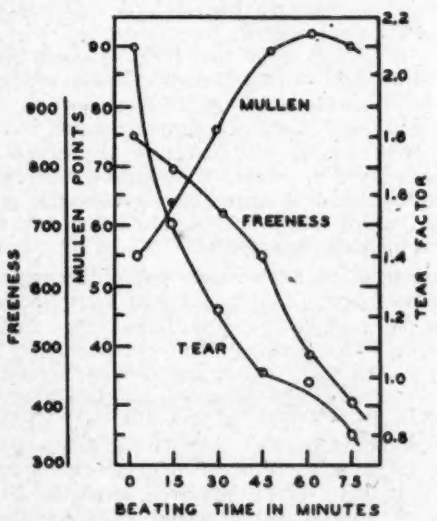

FIG. 1

Beater Evaluation of Bleached Sulphite

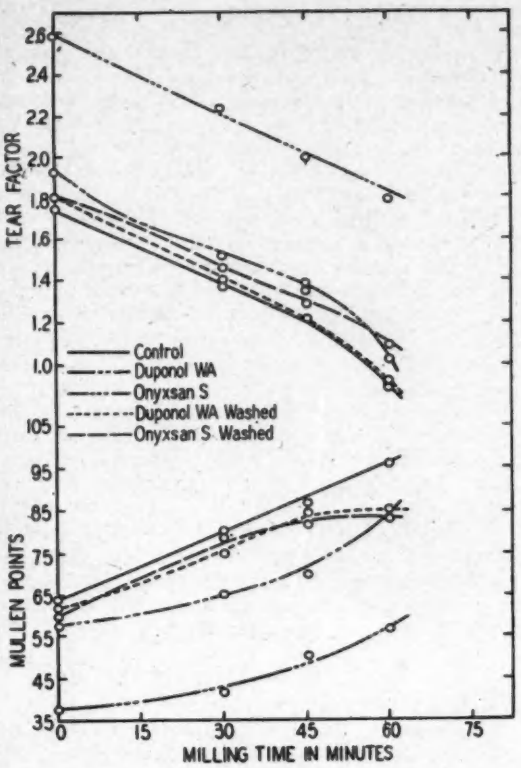

FIG. 2

Effect on Strength of Ball Milling of Pulp. Chemical Treatments which Decreased the Bursting Strength Caused the Tearing Strength to Increase. Excepting Small Variations, the Curves for Tearing Strength are Virtually the "Mirror Images" of Those for Bursting Strength. In Addition to These Phenomena, We May also Note the Commonly Observed Decrease of Tearing Strength with Increasing Sheet Density (Excepting an Initial Rise to a Maximum (20)), and the Increase of Tearing Strength with Increasing Fiber Length

Discussion of the relative magnitudes of the rupture work (w_r) and the frictional drag work (w_t) is facilitated by means of the diagrams presented in Fig. 3. The curve OA gives the stress-strain relationship for a fiber extended to the point of rupture. The work done is given by the area bounded by OABO. The elongation of the fiber segment lying between the bonds which flank the rupture is the distance OB. This distance is very small, being equal to the extensibility of the fiber multiplied by the stressed length. If the average stressed length is a fraction (f_1) of the fiber length, s, and if the extensibility of the fiber is f_2, the length OB will be f_1f_2s. Finally, the rupture work (w_r) will be less than the product tf_1f_2s, where t is the tensile strength of the fiber. The curve OCD is descriptive of the removal of a fiber intact from the mesh. At the beginning, there will be a small stretch of the fiber (distance OE), during which the force builds up until it becomes equal to EC, which is somewhat smaller than the tensile strength. Frictional drag then commences, and the frictional force falls off as the fiber is removed from the mesh because the number of contiguous fibers decreases as the fiber is removed. The average distance OD is of the order of half the fiber length and, if the force EC is just under the tensile strength BA, as it might well be, the frictional drag work (w_t), given by the area bounded by

OCDO, would be enormously greater than the rupture work (w_r).

The above is well illustrated by the analogy of a wire-drawing operation. Suppose that 100 feet of wire have been pulled through the die, and that an equal length has yet to be drawn. Let us also suppose that we may alter the friction in the die at will. If the tensile strength of the wire is 10 pounds, and the die friction is adjusted to 8 pounds, the wire may be drawn, and the work done in drawing the wire would be *800 foot-pounds*. If, on the other hand, the die friction is increased to the point where the wire is ruptured in tensile pull, the work done will be much less. Taking the extensibility of the wire as 5%, a stretch of 5 feet would be overcome with an average force in the neighborhood of, say, 6 pounds (the stress-strain curve is not linear up to the point of rupture), and hence the rupture work would be only about *30 foot-pounds*.

The frictional drag work (w_t) is seen to be of the order of $(1/4)t_t s$, where t_t is the initial frictional drag force (EC in Fig. 3). We have assumed that the average length of the frictionally held segment is about one-half the fiber length, and that the figure OCDO is approximately a right triangle. Hence, for the purposes of discussion we may write

$$w_r < t f_1 f_2 s \text{ and} \qquad (2)$$

$$w_t \cong (1/4) t_t s.$$

Equations 1 and 2 should be considered together.

The foregoing theory may now be applied to the explanation of some of the known phenomena associated with tearing strength.

1. *Tearing strength-beating time relationship.* In the initial stages of beating, there is virtually no bonding between fibers. The number of fibers ruptured in a tear is relatively negligible ($m = 0$), so that the energy of tearing goes into pulling fibers from the mesh. The frictional drag work (w_t) is itself at a minimum, because the lack of fiber bonding causes the sheet to have low density, and the forces of contact between the fibers is low. Hence t_t is low. As the beating time increases, the sheet becomes more compact—due to increased bonding—and the frictional drag work becomes greater. The number of fibers now ruptured grows, but n, the number of fibers dragged from the mesh intact, is not relatively reduced nearly as much as the frictional drag force is increased. In consequence, the tearing strength will at first increase. Eventually, however, n will be substantially reduced, and m increased through increased beating, so that the first (and much smaller term) on the right side of Equation 1 grows, whereas the second term becomes smaller. That is, increased beating causes increased bonding strength and a consequent increase in number of fibers ruptured in tension and a corresponding decrease in number of fibers simply pulled from the mesh without failure. Since the frictional drag work per fiber is much greater than the rupture work, any decrement in n will cause the tearing force to decrease. Finally, when the degree of beating is so great that virtually all $(m + n)$ fibers involved in the tearing are ruptured, the tearing force, according to Equation 1, will be relatively insignificant. To summarize, the frictional drag work per fiber increases rapidly in the very early stages of beating, thus accounting for the initial rise in the tearing strength-time curve; however, as beating proceeds, fewer fibers are pulled intact from the mesh and, since the frictional drag work per fiber is very much greater than the rupture work, the energy required to tear the sheet diminishes.

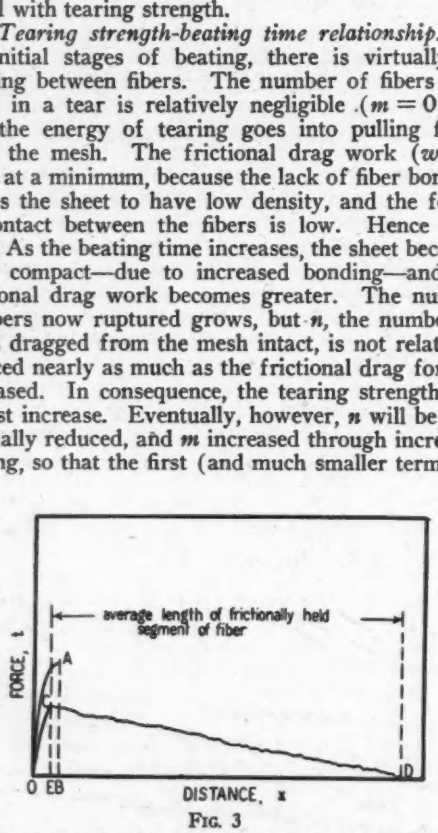

FIG. 3

Stress-Strain Curve for Fiber Stretched to Failure (Curve OA), and Force Versus Displacement Curve for Fiber Pulled from Mesh (Curve OCD)

It would seem that the upper extreme in tearing strength would be found in a sheet composed of long, strong fibers tightly enmeshed, *but not so tightly enmeshed that the fibers would rupture rather than pull out intact.* The lower extreme is found in a sheet of homogeneous, nonfibrous structure, in which all the energy of tearing goes completely into rupturing the material.

2. *The dependence of tearing strength on fiber length.* Equation 2 clearly shows the influence of fiber length, s. As the fiber length increases, the frictional drag work per fiber increases, and hence the tearing strength increases, which is a well known relationship. (If it were possible to obtain fibers of sufficient length to cause greater tensile rupturing of fibers through more thorough enmeshment, under conditions of similar tensile strength and degree of bonding between fibers, theory predicts that tearing strength would decrease with increasing fiber length.)

3. *The dependence of tearing strength on fiber-fiber bonding strength.* If the papermaking stock is beaten to a degree beyond the early stage in which increased fiber bonding increases tearing strength *indirectly* by increasing the tightness of the fiber mesh, the addition of an agent which will decrease the bonding strength will cause an increase in the tearing strength (*see* Fig. 2). Agents causing increased bonding will, in general, decrease the tearing strength. Starch, a common bonding agent, generally causes the tear to drop somewhat, although the decrement is usually small and, under proper conditions, the addition of starch may cause a small increment. Improved bonding will, of course, decrease n by increasing m. One should not overlook the possibility of certain bonding agents having a tearing strength *per se*, which would tend to inhibit the drop in tear due to increased bonding.

In concluding our remarks on the theory, it might be pointed out that the presence of a viscous material in the paper would be expected to increase the tearing strength by enhancing the frictional drag work (w_t). Obviously, such material would have to possess extremely high viscosity and tackiness before an appreciable effect could be observed. If the material were sufficiently viscous to act like a solid, its effect might be more like that of a bonding agent—that is, it might reduce the tearing strength. Furthermore, the rate of tearing would be expected to have an important bearing upon the frictional drag work

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if this latter quantity were appreciably influenced by the presence of a viscous material. This last consideration suggests a query regarding the influence of rate of tearing in the case of a normal sheet of paper. The Elmendorf method produces a tear at a rather high, essentially constant rate, whereas tearing by hand is usually done at a low rate. The literature contains only mention of the possibility of an effect resulting from a change in the rate of tearing the paper.

Comments on the Elmendorf Tearing Tester

There are few instruments in existence based on methods so simple, straightforward, and intrinsically accurate as that due to Elmendorf, and it appears from many studies that the Elmendorf-Thwing instrument is an excellent embodiment of that method. Having once properly calibrated this instrument (*12, 21*), it should remain in accurate calibration. Excepting certain rather obvious mechanical maladjustments which could be noted by any observant operator, the only quantities fundamentally influencing the accuracy to any appreciable extent are Wh, which is the product of the weight of the sector (W) and the distance between the axis of rotation and the center of gravity (h), the initial angular amplitude of swing, and the accuracy of subdivision and location of the scale. To modify these quantities would require drastic mechanical change of the sector.

There are certain sources of small discrepancies, none of which is ordinarily of any significance. The weight of the specimen causes a very small, spurious increment to the scale reading (*12*). Friction in the pointer bearing causes an error which it is attempted to eliminate by adjusting the pointer stop so that, with no specimen in the instrumental jaws, the pointer will fall upon the zero of the scale. It has been pointed out that this procedure is not theoretically correct (*22*), but computation shows that the theoretical error is quite small. It can be shown that the instrumental force is given by Equation 3 (*18*):

$$F = (1/2e)[Wh(\cos(\theta'_1 - s/r) - \cos\theta_o) - L(\theta_o + \theta'_1 - s/r)] \qquad (3)$$

in which

F = The average tearing force. (The actual instrumental scale is divided to give one-sixteenth of the actual force required to tear any number of sheets present between the jaws.)

e = The length of the line of tear—4.3 cm. in the Elmendorf-Thwing instrument.

W = The weight of the sector pendulum (exclusive of the weight of the pointer).

h = The distance between the axis of rotation and the center of gravity of the sector pendulum.

θ'_1 = The angular amplitude (in radians) of the pendulum at the end of the first half-oscillation when no specimen is in the jaws, and the pointer rests against the stop during the half-swing in the normal manner.

θ_o = The initial angular amplitude.

s = The arc distance along the scale from the zero to the actual deflection of the pointer.

r = The radius of the scale for the arc along which s is measured.

L = The sum of the frictional moments in the ball bearing and in the pointer bearing. (In Equation 3, put $s = 0$ and $F = 0$ and solve for L; the result may then be substituted back in Equation 3.)

To illustrate how well the adjustable pointer stop accounts for friction, computation with the help of Equation 3 shows that the error at the 20-gram marking would not be in error by 5% until the friction became so great that the pointer stop would have to be moved to the left of central position by approximately *80 mm.* The normal displacement required for the pointer to fall upon the zero is in the neighborhood of 5 mm. Even for full-scale deflection (100 grams) the displacement of the pointer stop corresponding to a 5% error would be large, being of the order of 52 mm. It is, therefore, readily seen that the criticism made by Mallett and Marx (*22*) is not of much consequence.

As Wells (*23*) has pointed out, the principal causes for discrepancies between data obtained on different instruments are probably the following: movement of the instrument after leveling and adjusting, differences between the conditioning atmospheres, and differences in the treatment of data for specimens exhibiting splitting, all of which causes for discrepancies may be eliminated by careful, intelligent action on the part of the laboratory operators. The literature contains some data and comments on an error due to multiplicity of test specimens simultaneously tested (*6, 9, 12, 15, 21*). It appears from the published data that the tearing force (computed to a single sheet) varies most markedly from a common average (for various numbers of plies) when a *single* sheet is employed in the test. Discrepancies attributable to this cause are supposedly minimized, in general, when the number of plies is taken to give an instrumental reading somewhere between 30 and 40 grams (*21*). It would seem, however, that the use of a single ply should be avoided wherever possible and that, in any case, the number of plies used for the tearing test should be specified in the report.

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[FROM OUR REGULAR CORRESPONDENT]

PHILADELPHIA, Pa., January 31, 1944—Disclosure by OPA of the existence of a flourishing "black market" in gasoline and fuel oil promises to lead to the imminent arrest of seven in York county, according to an announcement during the week of the Harrisburg office. Warrants for the arrests were "in the process of preparation"—in addition to four others taken into custody in Washington,—in an investigation into illegal circulation of obsolete ration coupons worth 5,000,000 gallons of gasoline and 15,000,000 gallons of fuel oil.

The district office of OPA at Harrisburg first noticed the extra coupons in circulation and notified national headquarters leading to the investigation which OPA said had shown the circulation and cashing of both good and expired stamps. Acting District Director Frank J. Loftus declared five lots of coupons were sent to a Washington salvage firm for destruction and later shipped to a York county concern as waste paper.

Among the four persons under arrest at Washington is said to be an employee of the Penn Paper and Stock Company. The names of the other three persons arrested were not disclosed by the OPA. However, William S. McClellan, vice president of the Glatfelter Paper Company, said that, to the knowledge of company officials, no arrests had been made among the employees of the company in Spring Grove. No charges have been brought against either the salvage company or the paper mill. Investigator Cullison explained that reports were received of many loose coupons appearing in the vicinity of York and that he traced the leak to the paper mill. He then conferred with company officials who, he said, were unaware of what was taking place.

Syracuse Alumni to Meet

The alumni of the New York State College of Forestry at Syracuse University who specialized in pulp and paper will hold their annual luncheon at the Hotel Commodore on Wednesday noon, February 16th. All those who expect to attend should notify Richard T. Bingham, Technical Association of the Pulp and Paper Industry, 122 East 42nd street, New York 17, N. Y., so that the arrangements may be completed.

DOUBLE PROTECTION
for your shipments

STANLEY STEEL STRAPPING
plus
STANLEY CAR BANDING

Packing and shipping is speeded up and simplified – shipments arrive in good condition – troublesome damage claims are reduced when you provide the double protection of Stanley Steel Strapping and Car Banding.

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Rough rides are no threat to skids or complete shipments when protected with Stanley Steel Strapping

PROMPT SHIPMENTS To War Production Plants

THE STANLEY WORKS STEEL STRAPPING DIVISION NEW BRITAIN, CONNECTICUT

Obituary

John E. A. Hussey

John E. A. Hussey, 82, New England sales agent of the International Paper Company, with offices at 45 Milk street, Boston, passed away January 27 at his home, 50 Marshal street, Brookline, Mass. He was, perhaps, the oldest man actively engaged in the newsprint industry in the United States.

Connected with the paper manufacturing industry for more than 65 years, he was known far and wide in the newsprint trade. Mr. Hussey began with the old Russell Paper Company with mills at Bellows Falls, Vt., and Franklin, N. H., as an office boy in the concern's Boston headquarters on July 22, 1878. He rose to the position of salesman and on Sept. 1,

JOHN E. A. HUSSEY

1886, he went with the Glen Manufacturing Company of Berlin, N. H., as a salesman. He remained with the Glen Company until the International Paper Company was formed on Jan. 31, 1898. He became sales agent and continued in that position until his death. He was often referred to as the dean of the industry.

Mr. Hussey is survived by his daughter, Mrs. Gertrude Hussey Miller of Brookline and a granddaughter, Miss Jane Miller, also a brother, George F. Hussey of Brookline.

The funeral was held on Saturday afternoon, January 29 with services at 3 o'clock at the Church of Our Saviour, Brookline.

W. L. Edmonds

W. L. Edmonds of Wausau, Wis., one of the founders of the Wausau Paper Mills Company, Brokaw, Wis., died January 21 at Memorial hospital at Wausau. He was 81 years old.

Mr. Edmonds came to Wausau in 1899 from Oconto Falls, Wis. After the new paper company was formed, he became its general manager and retired in 1935. He was also vice-president of the Record-Herald Company, publishers of the Wausau Daily Record-Herald, and was active in Masonic circles.

About a year ago a life membership was presented Mr. Edmonds in the American Pulp and Paper Mill Superintendents Association during a meeting of the Northwest division in Wausau. The son of a Methodist minister, he was prominent in church activities in Wausau. He had been a member of the Masonic lodge and affiliated bodies for more than half a century, and was a charter member of the Wausau Club and the Wausau Country Club.

Survivors are five children, Thorpe of Winnetka, Ill., Charles of Wausau, Lieut. Hobart, Fairhope, Ala., Mrs. Kenneth Lawson, Neenah, Wis., and Mrs. Ernest J. Dawley, Carmel, Calif. Mrs. Edmonds died September 24, 1928.

Huntington P. Faxon

Huntington Pope Faxon, 52, president and treasurer of The Rogers Paper Manufacturing Company, Manchester, Conn., and director of various other companies, died suddenly January 21. His residence was at 22 Highland street, Cambridge, Mass.

Mr. Faxon was born in Brookline, Mass., and received his education in Brookline schools and at Harvard College, from which he was graduated in 1912. He was a member of the Harvard Club of Boston.

Among companies of which he was a director were the Wolverine Power Company, in Michigan, and Carman & Co., New York.

There are living his wife, Laura (Greenough) Faxon, four daughters, Mrs. Wendell J. Tobey, Mrs. Ralph H. Willard, Jr., and the Misses Virginia and Hope and three grandchildren.

Funeral services were held January 24 at Christ Church, Cambridge. Interment was in Cambridge Cemetery.

William Butler

William Butler, a former superintendent of the Glassine Paper Co., West Conshohocken, Pa., died at his home in the Yeakle Apartments, 412 W. Marshall street, this morning. He was the husband of Julia Elliot Butler.

Mr. Butler, who was born March 11, 1872 in Chestnut Hill was a son of the late Hugh and Annie Donnelly Butler. He began his association with Glassine Paper Company in 1916. During recent years he was a paper consultant there.

He is survived by his wife, a daughter, Sara A. Carns, a son, William E. Butler, and a brother, Thomas.

Services were held at The Boyd Funeral Home, 718 Swede street. Burial was in Sharps Cemetery, Providence, Md.

Hilliard A. Smith

Hilliard A. Smith died January 9 at the Jefferson Hospital, Philadelphia, Pa., at the age of 59. He had been associated with The J. L. N. Smythe Company for his entire business career, completing last September his fortieth year of active, loyal and successful service. He was the senior member of their 25 Year Club.

Mr. Smith was widely known by many large manufacturing and business firms of Philadelphia, Trenton and Wilmington. He was also held in high esteem by many mill men.

He is survived by his wife, Mrs. Jean Gavitt Smith residing at Cynwyd, Pa.

PULP AND PAPER MEN MEET AT MONTREAL

(Continued from page 7)

pulp and paper products would grow from 30,000,000 tons per year to about 200,000,000 tons per year.

"Such a demand for pulp and paper may seem to many of us to be useless day-dreaming."

Importance of Lignin Research

Dr. Purves, of McGill University, in describing the work of the Industrial and Cellulose Division, expressed the hope that the research experts and others in the association will transmute knowledge into power to put lignin, the non-cellulose content of wood which usually goes to waste, to large scale economic use in the post-war period.

"Knowledge is power," said Dr. Purvis. "And I hope that we in the association will transmute this knowledge into power to put lignin to large-scale economic use in the early post-war years. Some fundamental studies planned for the Industrial and Cellulose Chemistry Division are directed toward this objective, which is an important part of the more general problem of utilizing the half of the wood that is at present often wasted.

"First priority is given at present to work in the national interest, and I am sure that this war-time policy has your support. This work for the nation is restricting normal peacetime pursuits of the division, but the institute has before it an extensive program of research."

Spruce Budworm Ravages

One of the most interesting addresses at the sectorial meetings was that of Dr. J. J. DeGryse, chief of the forest insects investigations for the Dominion Government, who spoke particularly on the measures taken to combat the ravages of the spruce budworm. He said:

"Today, the spruce budworm is seriously affecting balsam and white spruce over an area of about 45,000 square miles in Ontario south of the height of land, and in western Quebec. The trend of the attacks is eastward in Quebec and westward in the Lake Nipigon area.

"Over those vast sections, trees are dying or are in danger of being killed within the next four to five years.

"What the budworm has done to our balsam stands can be imagined from official figures which show that, in Ontario alone where the balsam stands are estimated at 25,000,000 cords, about one half of all this has already fallen victim to the budworm. Millions of cords of white spruce, also, has been destroyed. And more wood is going. In Quebec the forest is threatened with this creeping death; trees are dying in large numbers.

"What is the cause of this?" he asked. "The budworm flourishes where balsam matures and has not been used; in other words, if man does not use the balsam in time, nature does. Another contributing factor is that there is too much balsam in large areas of forest today, as compared with other species of trees. The answer to this situation is sound forest management."

Prizes and Awards

An interesting feature of the proceedings was the offer of a prize of $1,000 for the best suggestion leading to "greater use of hardwoods in the manufacturing of newsprint." The offer was made on behalf of the Ontario Paper Company, and it was stated that details regarding the date and conditions in connection with the award would be announced later.

R. L. Weldon presented a medal to E. Howard Smith of Montreal, retiring President of the Association to mark Mr. Smith's services to the Industry during his term of office.

Mr. Smith presented a silver medal to Fred L. Allen, Manager and Vice-President of Wartime Machine Shop Board of the Canadian Pulp and Paper Association, to mark services rendered while holding that office.

Fred L. Allen of Montreal presented a silver medal to Francois Faure of Montreal to mark his services to the Industry while acting as chairman of the Pulpwood Committee of the Pulp and Paper Industry of Canada.

The annual awards of the Technical Section were as follows:

W. H. deMontmorency, Board Mill Superintendent of the Gair Company, Canada, Ltd., Toronto, was presented with the I. H. Weldon Memorial Gold Medal donated by A. L. Dawe, of Consolidated Paper Corporation, Ltd., Montreal, to the senior member of the Technical Section who presented the paper of most outstanding value at the previous annual meeting. Mr. deMontmorency's paper, submitted at the 1943 session, was entitled "Stock Preparation, in Paper Board Mills".

F. X. Guimond, Control Superintendent, Canadian International Paper Company, Gatineau, Quebec, was presented with the Technical Section Service Award for his work during 1942-43 as chairman of the sulphite committee of the Section. This annual award is made possible through the generosity of F. Gerald Robinson, of Montreal, past president of the Canadian Pulp and Paper Association.

The annual awards of the Woodlands Section were as follows:

The Ontario Paper Company Limited Award for the best paper on logging mechanization, "Drag Line Arrangement for Sweeping Pulpwood from Banks of Lakes," to J. L. Kelly, of Price Brothers & Co. Limited.

Price Brothers & Co. Limited Award for the paper "The Woods Labour Problem Discussed from a New Angle," to Dr. Paul L. Rivard, of the Canadian International Paper Company.

The Ellwood Wilson Award, donated by F. G. Robinson, to F. A. Harrison, of the Canadian International Paper Company, for the best industrial application of studies undertaken by the Woodlands Section and the Pulp and Paper Research Institute, relating to efficiency in logging.

The J. A. Bothwell Award, donated by the Brompton Pulp and Paper Company Limited, for meritorious achievement in forest conservation, to Ernest Dupuis, Forester of the Brompton Company.

In addition, two prizes were given by J. N. Stephenson on behalf of the Pulp and Paper Magazine of Canada for skits prepared for use in logging camps: first prize to J. E. Bernier, of the Canadian International Paper Company, for his article "Incognito",

dealing with instruction of woods labour in the efficiency of filing saws; second prize to Gordon Bailey, of the Great Lakes Paper Company, for an article prepared in co-operation with Mr. Bernier on "The Happy Horses" and dealing with proper use and treatment of bush horses.

War Work in the Industry's Machine Shops

A feature of the convention was an exhibition of samples of war products made in the machine shops of the various pulp and paper companies, under the supervision of the industry's war time machine shop board. The total value of those products produced last year by the newsprint mills machinists in their "spare time" was about $4,200,000 as compared with $2,431,981 the previous year. All this work was done on a non-profit basis. The products included numerous mechanical parts for ships and guns, etc. The exhibition, however, does not tell the whole story. It does not show for instance, how many skilled mechanics were loaned by the pulp and paper mills to munitions factories to speed production, and help train and instruct others.

Operators of the mills, cooperating in the plan to train and supply skilled men, actually introduced even correspondence courses in mechanics for any men who showed the necessary aptitude. The cost to the man learning the trade was $64.25 payable at $1.25 per week. The companies paid the remainder of the expenses for course texts for instructors, wages earned for hourly paid instructors, and supervision.

Today, virtually every one of the 83 pulp and paper mills in Canada which has a machine shop, has adopted some plan of training men. Courses are being given in machine shop work, blacksmithing, pipe fitting, welding, millwrighting, tinsmithing, steam plant work, electrical work.

Must Stretch Pulp for Book Paper

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., Feb. 2, 1944—Manufacture of book papers, which include most of the graphic art papers except newsprint, have been told that they should stretch their pulp allotments to make as much paper as possible, the War Production Board said today. This advice was given by WPB officials at a meeting of the Book Paper Manufacturers Industry Advisory Committee.

The WPB Pulp Allocation Office has set aside 236,121 tons of pulp from which manufacturers are expected to produce a minimum of 344,000 tons of paper during the first quarter of 1944, Henry G. Boon, deputy director of the Paper Division and Government presiding officer at the meeting, told representative book paper manufacturers present.

Estimates of the industry were that they could produce 435,000 tons of paper from 298,000 tons of pulp, but equitable distribution of pulp to meet wartime demands for essential papers prevented the allocation of more than 236,121 tons of pulp for book papers, the manufacturers were told. Continued shortages of both pulpwood and pulp, due largely to lack of woods labor and trucks, made allocation necessary, and required the use of waste paper and other fibers to increase the area of paper produced.

Although manufactuers are not restricted as to the production of specific grades of book papers, they are expected to produce the normal usable grades, even if some do not come up to peacetime standards, WPB officials said.

Collections of waste paper are gradually increasing and may reach 600,000 tons in January and, if paper and paper board mills continue to cooperate to keep the paper coming in regularly, collections may approach 700,000 tons a month, approximating about 68 per cent of recoverable paper, Rex W. Hovey, director of the Paper Division, said. Sorting, baling and collecting are important factors in the drive, he said, adding that he believed the corner had been turned as far as trucks were concerned, but that the maintenance problem would remain with shortages of materials and labor problems.

Recommendations as to pulp allocations for the second quarter were requested by Mr. Boon, who appointed the following as members of a Book Paper Task Committee to make a study and report February 1: Dwight L. Stocker, Michigan Paper Company, Plainwell, Mich.; J. R. Kimberly, Kimberly-Clark Corporation, Neenah, Wis., and Austin M. Story, Chillicothe Paper Company, Chillicothe, Ohio.

Violating Ceiling Prices Charged

[FROM OUR REGULAR CORRESPONDENT]

PHILADELPHIA, Pa., January 31, 1944—The OPA filed a triple damage suit against a Philadelphia waste paper concern yesterday on charges of violating ceiling prices in the sale of waste paper to processing mills. It was the first such suit against a paper firm in the State. The defendants' names before the U. S. District Court are Mrs. Sarah Denenberg, and her two sons, Nathan and Maurice, joint owners of the Philadelphia Waste Paper Company, 2305 Cherry street.

OPA accuses the firm of adding "improper" brokerage and loading fees totaling $812.26 on several shipments of waste paper. OPA asks triple damages of $2436.78 and also seeks an injunction to prevent further reputed violations.

TAPPI Notes

Allen Abrams will return to the Marathon Paper Mills, Rothschild, Wis., on February 1st. Dr. Abrams has been with the Office of Strategic Services in Washington, D. C.

The Technical Committee of the Glassine and Greaseproof Manufacturers Association has tested 70-lb. Cumberland Gloss made by the S. D. Warren Company as a substitute for an 80-lb. paper of the same grade as mentioned in TAPPI Standard No. T 454 m-42. The committee finds that the 70-lb. sheet will be satisfactory for use as a backing sheet until such time when the 80-lb basis sheet is again available.

The TAPPI M. I. T. Alumni will hold a luncheon on Tuesday, February 15, at 12:30 at the Engineers Club, 32 West 40th street, New York, N. Y.

Paper Workers Open Headquarters

CINCINNATI, Ohio, January 31, 1944—The Paper Workers Organizing Committee, affiliated with the Congress of Industrial Organizations, announces the opening of committee headquarters at 1104 Keith building, Cincinnati, Ohio. Allan S. Haywood is chairman, Robert J. Davidson, director and Harry Sayre, Secretary.

FINANCIAL NEWS

New York Stock Exchange

High, Low and Last for Week Ending January 29, 1944

STOCKS

	High	Low	Last
A. P. W.	2⅜	2⅜	2⅜
Armstrong Cork Co.	39½	39⅛	39⅛
Celotex Corp.	12	11⅝	11⅞
Celotex Corp., pf.	17⅝	17⅜	17⅝
Certain-Teed Products Corp.	6⅛	5¾	6
Certain-Teed Products Corp., pf.	61⅞	60	60
Champion Paper & Fibre Co.	27⅜	25⅞	26⅛
Champion Paper & Fibre Co., pf.	110¾	110¾	110¾
Congoleum Nairn Co.	22½	21⅞	22⅛
Container Corp. of America	21	20⅛	20⅛
Continental-Diamond Fibre Co.	11¾	11½	11¾
Crown-Zellerbach Co.	16¼	16	16⅛
Crown-Zellerbach Co., pf.	98½	97¼	97½
Dixie Cup Co.	15¾	15½	15¾
Dixie Cup Co.—A.	44¾	44	44¾
Flintkote Co.	20¼	19⅝	20¼
Flintkote Co., pf.	105	104⅞	105
Robert Gair	3⅛	2⅞	3
Robert Gair, pf.	15¾	14½	15
International Paper Co.	14⅜	13⅝	14
International Paper Co., pf.	68⅞	68	68⅞
Johns-Manville Corp.	90¾	88	88¾
Johns-Manville Corp., pf.	128¾	128¼	128¼
Kimberly-Clark Corp.	33	33	33
MacAndrews & Forbes	....	....	....
MacAndrews & Forbes, pf.	....	....	....
Masonite Corp.	39½	39¼	39¼
Mead Corp.	8¾	8½	8½
Mead Corp., pf. A—6%	86	84½	84½
Mead Corp., pf. B—5½%	74¾	74	74
National Container Corp.	13	12⅝	12¾
Paraffine Companies, Inc.	48	47	47
Paraffine Companies, Inc., pf.	106	105	106
Rayonier, Inc.	13⅜	12⅝	12⅝
Rayonier, Inc., pf.	30	29	29
Ruberoid Co.	27⅜	27	27
Scott Paper Co.	40	40	40
Scott Paper Co., pf.	110	109½	110
Sutherland Paper Co.	29¾	29¾	29¾
Union Bag & Paper Corp.	9¾	9½	9¾
United Paperboard Co.	4¼	4⅛	4¼
U. S. Gypsum Co.	74	72¾	74
U. S. Gypsum Co., pf.	171½	171½	171½
West Virginia Pulp & Paper Co.	18¾	17¾	17¾
West Virginia Pulp & Paper Co., pf.	105½	104¾	105½

BONDS

Abitibi Pulp & Paper Co. 5s '53	73½	72½	73½
Celotex Corp. 3¾s '55	102½	102	102
Certain-Teed Products Corp. 5½s '48	101⅛	100⅛	101⅛
Champion Paper & Fibre Co. 4¾s '50	....	....	....
International Paper Co. 6s '55	108¾	107½	107¾
International Paper Co. 5s '47	104½	104	104⅛
Mead Corp. 3½s '53	....	....	....
West Virginia Pulp & Paper Co. 3s '54	....	....	....

New York Curb Exchange

High, Low and Last for Week Ending January 29, 1944

STOCKS

	High	Low	Last
Great Northern Paper Co.	33¼	32⅛	33¼
Hummel-Ross Fibre Corp.	4½	4¼	4¼
St. Regis Paper Co.	4½	4¼	4¼
St. Regis Paper Co., pf.	148¾	146¾	148¾
Taggart Corp.	....	....	....

BONDS

American Writing Paper Co. 6s '61	99	99	99

H. C. Lott Goes with United Paperboard

KALAMAZOO, Mich., January 24, 1944—Hubert C. Lott, whose home is in Three Rivers, employed as a cost accountant by the Sutherland Paper Company for the last three years, has resigned, effective January 15. Mr. Lott will go to the United Paperboard Company, New York City, to install a cost system and will remain there as cost accountant. Before coming to the Sutherland position Mr. Lott was for 17 years associated with the Eddy Paper Corporation.

Bulkley, Dunton Open New Office

SPRINGFIELD, Mass., January 31, 1944—Bulkley, Dunton & Co., with headquarters at 295 Madison avenue, New York, announce that John R. Whitney, formerly president of Whitney-Anderson Paper Company, Inc., has been installed as manager of their new Springfield office.

BAUERIZE REJECTS AND SCREENINGS

EVERY TON OF STOCK YOU SALVAGE COMBATS THE PULP SHORTAGE AND HELPS YOU BACK THE ATTACK.

With a Bauer pulper you can salvage and quickly prepare for sheet formation your screen rejects—turn such waste into A-1 Stock.

With a Bauer you can process semi-chemical and fiber, obtain plenty of rolling and pliableizing without cutting — develop greater freeness, raise your Mullen and tear.

Two sizes, 36" and 24" diameter discs with full range of plate patterns.

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SPRINGFIELD, OHIO

ARMY E NAVY
Bauer

PAPER TRADE JOURNAL

Title Reg. U. S. Pat. Off.

Henry J. Berger
EDITOR

Vol. 118 February 3, 1944 No. 5

COMING EVENTS IN PAPER INDUSTRY

American Paper and Pulp Association, Sixty-seventh Annual Convention and meeting, Waldorf-Astoria Hotel, New York, February 14-18.

Technical Association of the Pulp and Paper Industry, Convention, Commodore Hotel, New York, February 14-17.

National Paper Trade Association of the United States, Convention, Waldorf-Astoria Hotel, New York, February 14-17.

The New York Association Of Dealers In Paper Mills' Supplies, Annual Banquet, Commodore Hotel, New York, Tuesday, February 15.

New England Section. Technical Association of the Pulp and Paper Industry—Third Friday of each month at the Roger Smith Hotel, Holyoke, Mass.

Delaware Valley Section. Technical Association of the Pulp and Paper Industry—First Friday of each month at the Engineers Club, Philadelphia, Pa.

Lake States Section. Technical Association of the Pulp and Paper Industry—Second Tuesday of each month at the Conway Hotel, Appleton, Wis.

Kalamazoo Valley Section. Technical Association of the Pulp and Paper Industry—First Thursday of each month at the Park, American Hotel, Kalamazoo, Mich.

SURPLUS WAR PROPERTY

One of the most difficult problems that must be met in the immediate post-war period is that of reconversion. The Government will possess huge quantities of materials and manufactured goods. In addition to warehouses filled with stocks of guns and other ordnance, the Government will own a large amount of real estate, such as houses and industrial plants. A substantial part of the aggregate property will be in the form of military supplies unusable by civilians. The very large remainder, however, can be used and the method by which this surplus is disposed of will have a marked effect upon the readjustment of industry and trade to a peacetime economy.

One of the major economic problems arising from modern wars, that of disposing of surplus war supplies, has already appeared in a preliminary form, states the Guaranty Trust Company of New York in the current issue of *The Guaranty Survey*, published on January 25. "Its appearance", *The Survey* continues, "has drawn the attention of authorities to the vastly greater disposal problem that will inevitably confront Government and industry after the war, or during the final phase of the war, and has stimulated administrative and legislative efforts to prepare to meet the problem in an orderly and systematic way. Such plans, of course, must not be allowed to interfere with the paramount task of winning the war; for it appears that the hardest fight of all still lies ahead. Developments have shown, however, that adequate preparation for the handling of the disposal problem must be made in advance. The steps taken now may go far in determining the speed and smoothness of the transition from wartime to peace time economy and the strength of the foundation on which the post-war industrial structure must be built."

In referring to the problem as a task of great magnitude, *The Survey* points out that, "In its present stage, the problem is mainly one of redistributing raw material and productive equipment in such a way as best or promote the effective prosecution of the war. Contract terminations and 'cutbacks' in certain items, combined with unexpectedly favorable production records, are making supplies available for the use of producers of other items. As the war goes on, the disposal problem will increase both in magnitude and in scope. Materials and equipment, instead of being rechanneled into new branches of war industry, will become available for civilian use. Actual military and naval supplies in the possession of the armed forces will become surplus. And finally there will remain the most difficult and important problem of all—that of disposing of the huge industrial plants built and owned by the Government."

Citing some particulars of the huge investment of the Government, the article goes on to say that, "Only a rough idea of the size of the task and the strength of the economic forces, good or evil, that will be created in disposing of surplus war materials, can be gained from estimates of the total money value of the property involved. While it is apparently impossible to arrive at a close approximation, the amount of goods of all kinds that will eventually have to be disposed of has been placed by some authorities as high as $65 billion, a sum not far below the entire national income in a fairly prosperous year before the war. The Government's investment in war plants and facilities alone includes about 2,600 establishments valued at approximately $15 billion, and these totals will be even larger before the war is over. In the face of these complexities and uncertainties, it will be difficult task of the authorities charged with disposal to redistribute the many types of surplus property at such rates in such directions as will be most conducive to two main objectives: first, recovery of the largest possible share of the Government's original expenditure; second, maximum benefit, or minimum damage, to the general economic fabric of the nation. It is obvious that, if this tremendous problem is to be dealt with successfully, preparations cannot be made too soon."

Declaring that a program should be outlined now "the article states in part that, "Preliminary steps in the adoption of some such program should be taken without delay. Government agencies should immediately establish records of their war property, and any such property becoming surplus should be promptly placed under the control of the disposal authority. The whole plan should be administered with a view to the rapid stimulation of past-war employment, the effects on existing enterprise and the interests of the taxpayers. Equipment and supplies should be made available, as far as practicable, in

quantities permitting acquisition by small as well as large concerns—an objective that can be attained only in part, since many of the facilities consist of extremely large units. No class of property should be disposed of, or terms fixed, except after consultation with committees representing industry or industries most directly affected. Property should be disposed of, as far as possible, through regular trade channels by the industries that originally produced it."

In concluding the article states: "While sale is preferable to lease, there is no vital objection to the latter in cases where property cannot be promptly sold to advantage. Whether the property is sold or leased, however, the Government should not accept equity securities in payment. . . . When property is disposed of abroad it should be debarred from subsequent reimport into the United States, if such reimport would tend to have an adverse influence on domestic economy."

Sandy Hill Iron Works Hold Dinner

GLENS FALLS, N. Y., January 31, 1944—Paper making machinery took a back seat, and the role of the Sandy Hill Iron and Brass Works in the war was given wide acclaim, at the annual employees dinner of the company January 22.

An overflow crowd of 400, straining the capacity of the city's two principal dining places, heard official Navy praise of the Sandy Hill built automatic electric winch for LST boats, and in the same voice heard fervent pleas for increased production of these noteworthy devices.

When President Frank A. Juckett told of the progress made by the company, emphasizing that absenteeism was not one of their problems, and citing figures that showed a healthy employe-relationship. Lt. Comdr. J. Douglas Gessford, industrial incentive officer of the Navy, paid the compliment that "We came here to give you incentive; perhaps we should let your record be an incentive for us."

Equipment, and more equipment, is the need of the armed forces right now, he continued, and urged the workers to even greater output, exacting a pledge from the workers that they would attain a higher monthly quota starting at once.

Dr. Richard C. Tefft, Jr., chairman of the board of directors of Sandy Hill, was toastmaster. A brief talk was given by Almon A. Johnson, designer of the famed Johnson automatic electric winch. Philip J. Riley, treasurer of the firm, unveiled a plaque containing the names of 80 employes in service.

Dinner arrangements were made by Foster P. Doane, Jr., E. I. DiBiase, A. R. Stewart, Ellsworth La Barge, Harold Allen and Allen A. Lowe. Employes put on the musical and entertainment program.

Edward Bartsch Elected President

Edward Bartsch has been elected president and member of the executive committee of Rayonier, Inc. He had been executive vice president for several months and previously was an official of Chase National Bank of New York. He succeeds E. M. Mills, who becomes chairman of the executive committee.

Production Ratio Report*

(Production as per cent of six-day capacity)

COMPARATIVE WEEKLY SUMMARIES

Current Weeks—1943		Corresponding Weeks—1942	
December 18	89.1	December 19	87.9
December 25	70.0	December 26	63.3
January 1, 1944	72.1	January 2, 1943	75.9
January 8	91.7	January 9	85.7
January 15	91.2	January 16	88.1
January 22	89.2	January 23	87.9

COMPARATIVE MONTHLY SUMMARIES

Year	Jan.	Feb.	Mar.	Apr.	May	June	July
1942	104.5	103.9	102.9	100.4	95.3	87.4	75.8
1943	87.2	88.9	89.5	88.7	91.4	84.8	84.3

Year	Aug.	Sept.	Oct.	Nov.	Dec.	Year Avg.
1942	80.8	82.8	90.6	86.9	80.1	90.4
1943	91.0	88.3	89.6	90.6	82.8	87.9

COMPARATIVE YEARLY SUMMARIES

	1936	1937	1938	1939	1940	1941	1942	1943
Year Average..	80.4	79.8	71.5	83.4	85.6	97.4	90.4	87.9

* Based on tonnage reported to American Paper and Pulp Association. Does not include mills reporting to National Paperboard Association, except in isolated cases where both paper and paperboard are produced and separate tonnage figures are not readily available. Does not include mills producing newsprint exclusively.

PAPERBOARD OPERATING RATIOS†

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year Avg.
1937	83	89	89	91	88	80	69	77	72	70	57	47	75
1938	56	63	63	60	60	59	59	60	70	73	67	61	64
1939	65	73	76	74	69	73	68	77	82	91	88	77	77
1940	78	75	74	76	82	85	77	79	78	85	82	77	78
1941	81	88	89	89	91	94	92	98	95	99	98	90	92
1942	102	101	101	95	82	72	68	75	76	81	82	77	84
1943	86	88	94	94	96	94	89	96	94	94	93	87	93

Week ending Dec. 18, 1943—96 Week ending Jan. 8, 1944—86
Week ending Dec. 25, 1943—87 Week ending Jan. 15, 1944—93
Week ending Jan. 1, 1944—63 Week ending Jan. 22, 1944—93

† Per cents of operation based on "Inch-Hours" reported to the National Paperboard Association.

May Omit Some Writing Paper Grades

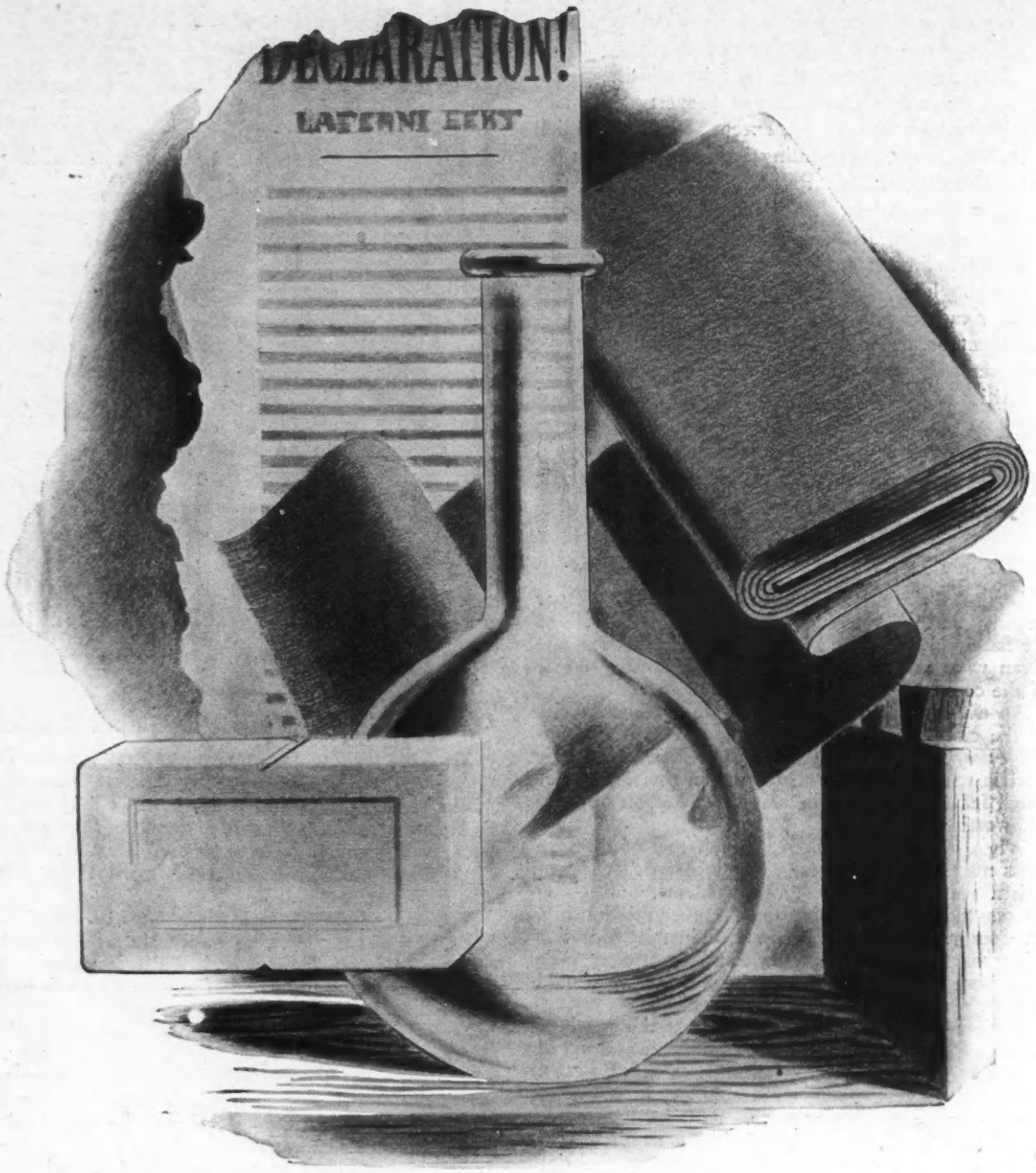
To meet writing paper requirements for the first quarter of 1944, approximating 222,534 tons, some of the higher grades and types of paper may have to be abandoned, some weights reduced, and more waste paper and filler will have to be used, Rex W. Hovey, director of the War Production Board Paper Division, has announced.

The paper industry as a whole must go on a "war basis," he told the Writing Paper Manufacturers Industry Advisory Committee. WPB is covering all approaches to the problems of getting as much paper as possible produced from a minimum of available pulp, and it feels it must now solicit further application of the ingenuity of the writing paper industry.

The meeting of representatives of the writing paper manufacturing industry was presided over by Henry G. Boon, deputy director of the Paper Division. Various phases of the writing paper problem were discussed, and experts presented statistics and the pulp allocation figures for the first quarter of 1944.

In connection with the allocations of pulp, Mr. Hovey informed the meeting that it was the intention of the WPB Forest Products Bureau and the Requirements Committee to keep as many paper mills in operation as possible. He urged cooperation in the dual drives to increase the cutting of pulpwood and collection of waste paper. Manpower and transportation, he said, are the bottlenecks handcapping the pulp and paper industry.

In order to secure recommendations as to pulp allocations for the second quarter, Mr. Boon appointed a task committee of three to report February 1. The members are Dan K. Brown, Neenah Paper Company, Neenah, Wis.; Henry Savage, International Paper Company, New York, N. Y.; and Maxwell Bardeen, Lee Paper Company, Vicksburg, Mich.



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Section of the
TECHNICAL ASSOCIATION
OF THE PULP & PAPER INDUSTRY
122 E. 42nd St., New York 17, N. Y.
Edited by R. G. Macdonald, Secretary

Water Vapor Permeability of Paper and Paperboard

Revision of TAPPI Official Standard T 448 m-41

This method is for the determination of the water vapor permeability of paper and paperboard under normal atmospheric conditions. It is considered generally suitable also for other sheet materials up to 1 inch in thickness. For testing at high humidity and temperature see TAPPI Method T 464 m.

Water vapor permeability is defined for this test as the weight of water transmitted per unit of time, per unit area measured while the specimen separates a dry atmosphere in a test cell from the standard atmosphere of 50% R. H. and 73° F. on the other face.

Apparatus

1. *Test Dish.* An open-mouthed cup or dish of such size and shape that it can be accommodated readily on the pan of an analytical balance. The opening should be as large as practical, an area of at least 30 sq. cm. being preferred. The test dish must be of such design that a wax seal can be made which will be impervious to leakage of water vapor and will define clearly the test area. Suitable designs for the dish with supporting rings and flanges are shown in Figs. 1 to 9, inclusive. Other modifications of these designs may be made, provided the principle of preventing edge leakage by means of a complete wax seal is retained.

2. *Template,* for use in defining the test area and effecting the wax seal, consisting of a circular metal disk ⅛ inch thick, with the edge bevelled to an angle of about 45 degrees. The diameter of the bottom (smaller) face of the template must not be greater than the diameter of the effective opening of the cell in contact with the specimen.

3. *Analytical Balance,* of 200-gram capacity, sensitive to 0.001 gram.

4. *Tare.* This shall be a blank specimen and dish assembly, similar to the test specimen assembly described under Procedure, except that no desiccant is contained in the dish. The purpose of the tare is to minimize in successive weighings the effects of extraneous influences, such as moisture absorption by dish, wax, etc., dust deposits, and changes in density of the confined air resulting from fluctuations in barometric pressure. The tare should be subjected, along with the specimen assemblies, to the conditioning atmosphere.

5. *Testing Room or Cabinet* provided with conditioned air maintained at 50% R. H. and 73° F. according to TAPPI Standard T 402 m, and continuously circulated at a rate not less than 500 feet per minute over the exposed surfaces of the specimens under test.

6. *Grill or Reticulated Rack* in the testing room or cabinet, capable of supporting the inverted specimens in a manner to afford free access of the circulating air.

Materials

A. *Desiccant,* with a powerful affinity for water vapor and a high drying efficiency—that is, a low vapor pressure after absorbing a large amount of water. The desiccant must remain essentially unchanged in physical condition and exert, while dry, no chemical or physical action other than dehydration effects on membrane materials with which it is in contact. The desiccant used must be in the form of small lumps, free from fines that will pass a No. 30 screen. (Anhydrous magnesium perchlorate made by the G. Frederick Smith Co., Columbus, Ohio, is recommended. This substance may be explosive at elevated temperature and should not be regenerated. Anhydrous calcium chloride is also suitable.)

B. *Wax,* for sealing the specimen to the testing dish, made up of equal parts of crude beeswax and rosin. This wax clings tenaciously to surfaces and is not brittle at ordinary room temperature.

C. *Petrolatum,* for application to the bevelled edge of the template in order to facilitate removal of the latter after sealing the test sheet to the dish. The petroleum jelly commonly used by druggists is suitable.

Test Specimen

The test specimens shall be representative of the material. At least four specimens from each sample shall be tested, half being attached to the cell with the wire side out and half with the felt side out.

Procedure

Place sufficient desiccant inside the dish to cover the sheet area to a depth of at least 15 mm. The following method of affixing the test specimen to the dish is for paper and for paperboards not over ⅛ inch thick: Cut the test specimen so that its diameter is equal to that of the larger diameter of the template. Place the sheet over the aperture of the dish and center it as closely as possible on the supporting

ring or flange. With the tip of the finger apply a thin film of petrolatum to the bevelled edge of the template. Wipe off any petrolatum which may have been deposited on the smaller surface of the template. Center the template with the smaller surface down, exactly over the specimen and dish opening. Flow molten wax into the annular space surrounding the bevelled edge of the template, using a medicine dropper to dispense the molten wax. Remove the template from the sheet surface as soon as the wax has cooled and solidified.

For paperboards over ⅛ inch thick, the method of preparing the test assembly is modified as follows: To prevent edge leakage, rotate the edge of the test specimen in molten wax of such fluidity that it does not penetrate into the edge more than 1/16 inch, suspend it inside the dish to a distance of about half the thickness of the specimen, and run molten wax around the edge of the specimen to seal it to the dish.

Weigh the assembly on the analytical balance to 0.001 gram, using the tare. Place the dish on the rack inside the testing room or cabinet in an inverted position so that the layer of desiccant is in direct contact and evenly distributed over the inner face of the test sheet and so that free access of the conditioned circulating air is provided on the exposed surface of the sheet.

Make successive weighings of the assembly at suitable intervals until a constant rate of gain is attained. For papers that are relatively pervious, the weighings should be frequent enough to complete the test before drops of liquid agglomerate are formed in the desiccant or caking of the desiccant occurs. These conditions will be indicated by a drift from the constant rate of gain, after which no readings should be recorded. Plot the weight gain against time. The slope of the resulting curve will furnish a measure of the water vapor permeability.

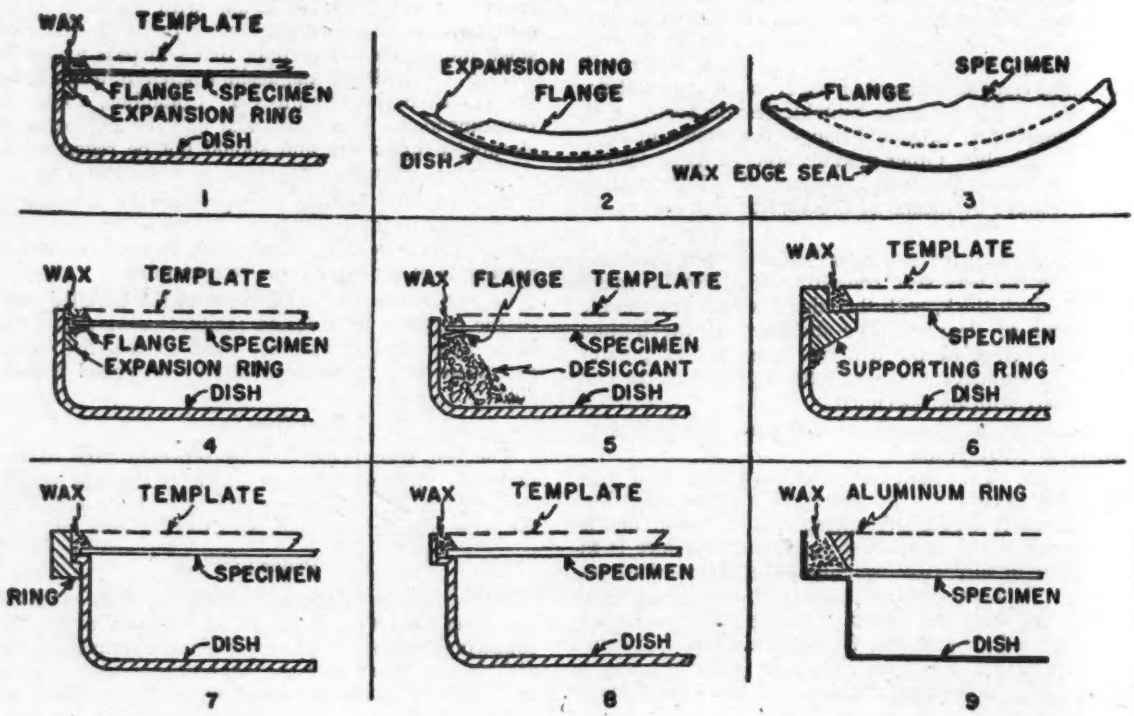
Report

The water vapor permeability shall be reported to three significant figures as grams per square meter or ounces per 100 square yards per 24 hours at 73° F. and for a moisture gradient defined in the preceding section. The calculation should be made for the period of constant rate of gain. For example, in a test run for 190 hours on an exposed area of 55 square centimeters (0.0055 sq. m.), assume that the rate of gain was substantially constant after 18 hours, and that during the subsequent 172 hours the moisture absorbed by the desiccant was 67 mg.; the water vapor permeability is then $\frac{0.067 \times 24}{0.0055 \times 172} = 1.70$ grams of moisture passing through 1 square meter of the material every 24 hours at 73° F. from 50% relative humidity on one face to desiccant in contact with the other. *Note:* Grams per square meter × 2.95 = ounces per square yard.

The permeability values shall be reported for each side of the sheet separately, the side designated in each case being that which faced the higher humidity in the test. A suitable code designation should be used to distinguish between the two sides of the material, such as Side I and Side II; or when there is an obvious difference between the two sides, such as Side I, waxed and Side II, unwaxed. The report shall state what desiccant was used.

Reproducibility of Results

Duplicate determination should give checks within 10%, depending largely on the variation in the sheet



FIGS. 1, 2, 3, 4, 5, 6, 7, 8 and 9

material itself. As the spread between very permeable sheets and those having a low permeability is at least a thousand fold, a precision of 10% on a given material will establish it quite definitely in the scale of permeabilities normally encountered in sheet materials.

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2. Abrams, Allen., and Brabender, G. J., *Paper Trade J.* 102, No. 15:32 (April 9, 1936); *Tech. Assoc. Papers* 19:121-130 (June, 1936).
3. Brabender, G. J., *Paper Trade J.* 108, No. 4:39 (Jan. 26, 1939); *Tech. Assoc. Papers* 22; 95:251 (June, 1939).
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5. Carson, F. T., *Paper Trade J.* 107, No. 18:59 (Nov. 3, 1938).
6. Water Vapor Permeability Symposium. *Tech. Assoc. Papers* 20:90-102 (1937).
7. Brabender, G. J., *Paper Trade J.* 110, No. 18:27 (May 2, 1940); *Tech. Assoc. Papers* 23:358-361 (June, 1940).

TAPPI Standards Adopted

On the basis of the votes received from the membership of the Technical Association of the Pulp Industry, the following tentative standards were advanced to official standards:

T 623 m-42 Determination of Sodium by the Sodium by the Uranyl Zinc Acetate Method

T 624 m-42 Analysis of Sulphate White and Green Liquors

T 625 m-42 Analysis of Sulphate Black Liquor

The negative votes and comments regarding T 451 m-40 Rigidity, Stiffness and Softness of Paper and Paperboard were considered sufficient by the TAPPI Standards Committee to justify holding this in its present status of a tentative standard.

The following revised official standards were approved:

T 2 m-43 Methoxyl Groups in Wood

T 200 m-43 Laboratory Processing of Pulp (Beater Method)

T 202 m-42 Chlorine consumption of Pulp

T 205 m-42 Forming Handsheets for Physical Tests for Pulp

T 209 m-43 Methoxyl Groups in Pulp

T 427 m-43 Saturating Properties of Roofing Felt

T 429 m-43 Qualitative Analysis of Mineral Fillers and Mineral Coating of Paper

Plywoods

The Chemical Publishing Company has recently issued an interesting 177-page book entitled "Plywoods" by Andrew D. Wood and Thomas G. Linn. This book is of interest to the paper industry because of the close relationship between plywoods and paper-base plastics.

The entire process of manufacturing from the tree to the commercial plywoods is given. Among the subjects covered are: physical properties of wood and plywood, manufacture of multi-ply, plywood production process; veneer drying, jointing and repairing; adhesives and their application; pressing, finishing, laminboards, composite boards and specialties; grading, testing and storing; wall panelling and applications. There are 192 illustrations.

The chapter on adhesive covers: glue and cements, casein, soya products and resins. A chart is included that shows the relative properties of commercial woods.

Copies may be obtained from the Book Department of the Technical Association of the Pulp and Paper Industry, 122 East 42nd street, New York, N. Y. at $4.00 per copy.

Type P Combustion Control Equipment

A new system of combustion control, said to make available to the smaller industrial and municipal power plant a regulation as effective and reliable as Leeds & Northrup's Metermax System brings to the large central station, has recently been developed by that company.

Applicable to boilers fired with coal, oil or gas, this system, known as Type P, continuously proportions fuel and air to steam demand, and at the same time, controls furnace pressure. To regulate fuel-feed and draft (either forced or induced), the system provides a simple electrical balance (using the Wheatstone Bridge principle) by which the settings of valves, dampers or vanes are varied in definite proportion to steam demand as directed by a Master Controller. The remaining draft damper or other device is simultaneously regulated by the Furnace Pressure Controller.

If for any reason the operator does not desire full automatic control, he can move any of the drive units from push button stations. Without leaving the panel, he can switch from (1) full automatic control to (2) base load control, and regulate air supply from a single push button, with fuel supply automatically following in the proper relationship and with furnace pressure automatic. He can, as easily (3) regulate both air and fuel from push buttons, with furnace pressure automatic. Or (4) he can switch to complete push button control and regulate each drive unit separately from the panel.

This independent operation of drive units allows the controllers to be serviced without interrupting boiler operation. Except for drive units, all equipment can be shipped on an easy-to-install panel. Or if preferred, equipment can be mounted on a complete boiler panel—along with draft gauges and other instruments.

To learn more about Type P Combustion Control, write Leeds & Northrup Company, 4934 Stenton avenue, Philadelphia 44, Pa.

Research Work by Arthur D. Little, Inc.

Research developments of the Arthur D. Little, Inc., laboratories are in combat use throughout the world, and during the past year further research was conducted on war projects, according to the report of Earl P. Stevenson, president of the Cambridge Industrial Research Organization, at its annual meeting on January 26. The meeting especially noted the completion of 25 years of service by Mr. Stevenson and 35 by Roger C, Griffin, vice president, who has been a director for 20 years.

The company's officers, all of whom were reelected at the meeting, are Earl P. Stevenson, president; Raymond Stevens, Thorne L. Wheeler and Roger C. Griffin, vice presidents; Henry G. Powning, treasurer; Frank N. Houghton, secretary; and Russel H. Stephens, comptroller. Directors for the coming year are: Earl P. Stevenson, Henry G. Powning, Roger C. Griffin, Horace S. Ford, W. Cameron Forbes, Randolph C. Grew, Royal Little, Charles E. Spencer, Jr., and Alexander Whiteside.

The Nature of the Cupriethylenediamine Cellulose Solvent*

By R. M. Levy[1] and P. Muffat[2]

Abstract

A comprehensive study of the nature of the cupriethylenediamine cellulose solvent is presented. A study of the factors involved in the various complex reactions of this solvent with cellulose is given, together with a complete summary of previous work on this subject. An attempt was made to bring theory and experimental fact into agreement, and a number of facts are presented that have been apparently overlooked in the past.

Since the presentation of the original paper on the use of cupriethylenediamine as a solvent for the disperse viscosity of cellulose *(15)*, considerable interest has been shown in the method and several modifications made *(5)* which indicate that this solvent is useful for both a precise and a routine means for determining the viscosity of cellulose. This solvent was found to possess many distinct advantages over the classic cuprammonium hydroxide which has been used quite extensively in recent years to measure cellulose quality. The merits of the cupriethylenediamine solvent over cuprammonium hydroxide have been pointed out in a previous paper *(15)* and also by Hatch *(5)* and others who have done considerable work with this solvent under various conditions.

Unfortunately much confusion exists as to the exact nature of these various cupriamine complex cellulose solvents. A tremendous amount of experimental work has been done to give some insight as to the nature of the various copper complexes, as well as their reactions with cellulose. A great deal of pioneering work has been done in this field by Traube *(17)* and Hess *(6, 7)*, and more recently by Jolley *(10)*. There is, however, considerable disagreement between the various workers as to the nature of these complex compounds, and from the evidence presented there appears to be some justification for such disagreement. It was for this reason that the authors decided to make a comprehensive study of the factors involved in the various complex reactions, summarize the previous work that has been done, and attempt to bring into agreement the facts concerning the nature of the actions of the cupriamine compounds, especially cupriethylenediamine. It is hoped that such a study will bring a better understanding forward which will aid in the future application of cupriethylenediamine to the problems of cellulose viscometry.

Previous Work

The theory of Traube *(17)* on the nature of cupriethylenediamine and its reactions with cellulose may be given in the following brief account:

Traube assumed that an aqueous solution of ethylenediamine saturated with cupric hydroxide formed the simple compound $Cu\ en_2\ (OH)_2$* in which the ratio of copper to diamine was in the exact molar ratio of 1:2. From investigations of the copper complexes of the simpler polyhydric alcohols such as glycerol and mannitol, and their similarity to the reaction of cellulose, he concluded that the interaction of cellulose with cupriethylenediamine could be expressed by the following equations:

$$2C_6H_{10}O_5 + Cu\ en_2(OH)_2 \rightleftarrows [Cu\ en_2]\ [C_6H_9O_5]_2 + 2H_2O \quad (1)$$

$$[Cu\ en_2]\ [C_6H_9O_5]_2 + Cu\ en_2(OH)_2 \rightleftarrows [(C_6H_9O_5)_2Cu]\ [Cu\ en_2] + 2\ en + 2H_2O \quad (2)$$

Equation (1) represents the formation of an alcoholate which further reacts with cupriethylenediamine to form the complex copper-cellulose compound given by Equation (2). These equations were used by Traube to explain the fact that saturated solutions of cupric hydroxide in aqueous ethylenediamine acquired the power of dissolving an additional amount of cupric hydroxide when cellulose was dissolved in them, and that after this "secondary" dissolution of cupric hydroxide the solution was able to dissolve a further amount of cellulose. The excess ethylenediamine set free was supposedly responsible for the dissolution of the further quantity of cupric hydroxide. Takamatsu and Horie *(16)* found that the addition of ethylenediamine to cupriethylenediamine solutions of cellulose caused an increase in the electrical conductivity and a decrease in the optial rotatory power, with the ultimate precipitation of the cellulose. This was also described in a previous paper *(15)* and the electrical conductometric curves given. This fact appears to be in agreement with the theory of Traube if the equilibrium is represented by Equation (2).

Lieser *(11)* considers that cellulose in cupriethylenediamine solutions exists as an addition compound in which the molar ratio of ethylenediamine to copper is 2:3, and that the anhydroglucose units in the micellar surface, assumed to be half the total glucose units, are involved in complex formation thus:

$$(C_6H_{10}O_5)_{\text{interior of micelle}} \left[C_6H_7O_2 \begin{matrix} \diagup OH \rightarrow Cu(OH)_2 \\ -OH \\ \diagdown OH \rightarrow \dfrac{Cu\ en_2(OH)_2}{2} \end{matrix} \right]_{\text{surface of micelle}}$$

Hess *(6, 7)*, and Trogus and Sakurada *(18)* obtained results similar to Traube for the "secondary" dissolution of copper and the formation of a copper-cellulose complex anion.

Jolley *(10)*, on the other hand, assumes that the active component responsible for cellulose dissolution and complex formation is the undissociated cuprimono-ethylenediamine rather than the cupri-di-ethylenediamine. He represents the equilibrium in the absence of cellulose as,

$$[Cu\ en_2]\ (OH)_2 \rightleftarrows [Cu\ en(OH)_2] + en \quad (3)$$

---

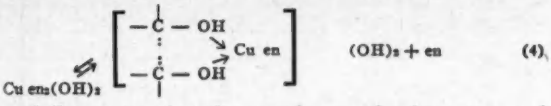
*To be presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry, Hotel Commodore, New York, N. Y., February 14-17, 1944.

[1]Member of TAPPI; Director of Research, Ecusta Paper Corporation, Pisgah Forest, N. C.

[2]Research Chemist, Ecusta Paper Corporation, Pisgah Forest, N. C.

*The symbol en is used to represent the ethylenediamine molecule, $NH_2 \cdot CH_2 \cdot CH_2 \cdot NH_2$.

and the equilibrium in the presence of cellulose as



Jolley states that the reaction mechanism proposed by Traube does not appear capable of explaining all of the experimental observations. No particular merit is claimed by Jolley for the mechanism he has proposed, but he states that it explains the experimental observations in a formal manner; that is, the effect of sodium hydroxide in increasing the solubility of cupric hydroxide in aqueous ethylenediamine solutions, the increase in conductivity on addition of ethylenediamine with ultimate precipitation of cellulose, and the ratio of copper-ethylenediamine-cellulose in the complex.

Jolley also found in the course of his experimental work that the ratio of diamine to copper in solutions saturated with cupric hydroxide varied from 1.78 to 1.89 depending on the concentration. In his studies of the cuprammonium hydroxide system he observed the effect of increasing the ammonia concentrations on the solubility of cellulose. In this latter system an increase in the ammonia concentration at constant copper content increases the solubility of cellulose, quite opposite to that which is observed in the cupri-ethylenediamine system. Jolley stated that no reason has ever been advanced to account for these differences in the two complex systems, and further stated that a satisfactory solution of all the problems raised by a study of the solubility of cellulose in solutions of the cupriamine bases requires a more fundamental knowledge of the equilibria existing in these solutions in the absence of cellulose than is at present available.

Hoffmann and Bruch *(8)* concluded from their studies of the cupriethylenediamine system by a partition method, that these solutions contain besides the ion $(Cu\,en_2)^{++}$, free ethylenediamine, $(Cu\,en)^{++}$ and $(Cu\,en_3)^{++}$. Rosenblatt *(12)* also deduced the existence of the $(Cu\,en)^{++}$ ion in saturated solutions, and found the cupri-di-ethylenediamine complex was present in solution as the di-aquo ion, $Cu\,en_2\,(H_2O)_2^{++}$, in which the copper atom exhibits a covalency of six.

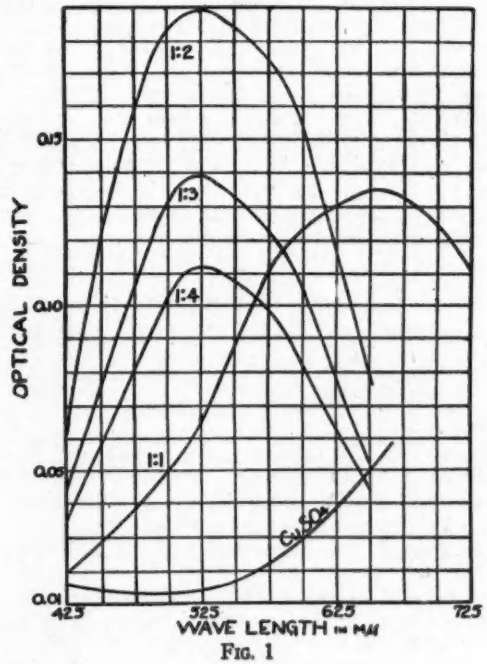


FIG. 1

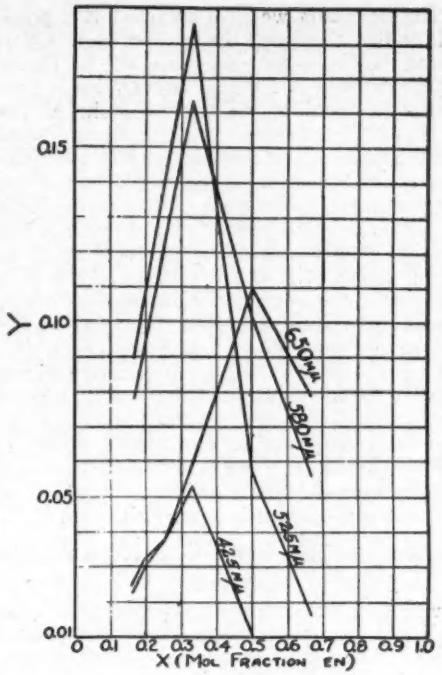


FIG. 2

Light-Absorbtion Studies

Vosburgh and Cooper *(19)* in a recent paper extended the original work of Job *(9)* for the spectrophotometric determination of the composition of complex ions in aqueous solution.

Since the spectrophotometer has proven to be of much value in elucidating the structure of complex ions in aqueous solutions, it was decided to examine the copper-ethylenediamine system by Job's method of "continuous variations" as applied by Vosburgh and Cooper.

In this method the optical density at a predetermined wavelength is measured with equal molar solutions of the two components mixed in varying proportion at constant volume. A value Y is found by taking the difference between the measured optical density and the optical density that the solution would have had if there had been no reaction on mixing. The concentration at which Y is a maximum determines the composition of the complex. The reader is referred to this excellent paper of Vosburgh and Cooper for details concerning theory and a complete discussion of the method.

Figure 1 shows the values of the measured optical density of 0.01 N solutions of copper sulphate and ethylenediamine at the various molar ratios of copper to diamine. Figure 2 shows the values of the difference Y, between the measured density and that calculated from the density at the same wave length of the pure copper sulphate solution, assuming no reaction on mixing the two solutions. The wave lengths used were selected according to the method given by Vosburgh and Cooper.

From these data we have obtained, it is possible to conclude that the ions $(Cu\ en_2)^{++}$ and $(Cu\ en)^{++}$ do exist, however, no evidence could be found here for the existence of the $(Cu\ en_3)^{++}$ ion. From the curves thus obtained it can be concluded that the $(Cu\ en_3)^{++}$ ion does not exist in dilute solutions.

Cole, Shreaves, and Bowden *(3)* in their work on the spectrophotometric properties of some complex copper-amine compounds have presented evidence for the existence of copper-triethanolamine complexes with the general formula, $Cu[N(C_2H_4OH)_3]_n^{++}$ where n equals 1, 2, and 3. Their results also indicate the possibility of a series of complex ions having the general formula, $[Cu(NH_3)_x(H_2O)_y]^{++}$ where x has values from 1 to 6 and $y = 6 - x$, for each value of x. They conclude from their studies that the cupric ion in aqueous solution has 6 as its coordination number, satisfied by solvation until a compound containing amine nitrogen is added to the solution, whereupon there is a displacement of water molecules from the sphere of influence of the ion with subsequent replacement by amine nitrogen.

Preparation of the Solid Cupriethylene Diamine Complexes

It was found that the cupri-diethylenediamine sulphate could be prepared by addition of concentrated solutions of ethylenediamine to copper sulphate in the molar ratio of 2:1. The salt crystallized out as blue-violet plates. The 1:1 compound could be prepared in a similar manner and formed light blue crystals. These compounds were purified by fractional crystallization from warm water.

It was observed that if the 2:1 compound was allowed to stand in a desiccator over ethylenediamine the ratio of amine to copper gradually approached the value of 3:1. This compound was presumably $(Cu\ en_3)SO_4$. It was found that the 3:1 compound was quite unstable in water and reverted to the 2:1 form with the liberation of free ethylenediamine. This can be shown by the following experiment: 1 mg. mole of $(Cu\ en_2)SO_4$(0.280 g) and 1 mg. mole of $(Cu\ en_3)SO_4$(0.340 g) were each dissolved in 500 ml. of distilled water and the transmission *(5)* at three wave lengths were determined for each solution with the following results:

Wave Length	Transmission %	
in μ	2:1 Compound	3:1 Compound
650	81.5	81.0
525	58.7	57.2
425	84.5	84.25

The difference in transmission at the three wave lengths for the two compounds show that they are

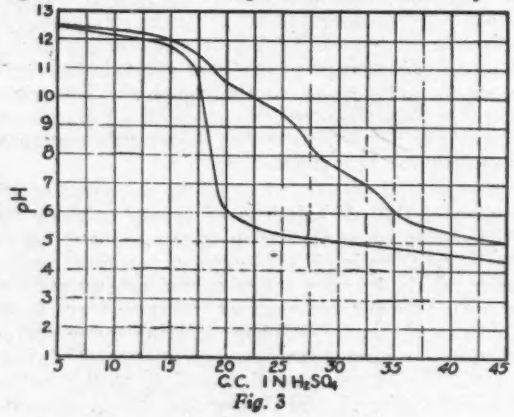


Fig. 3

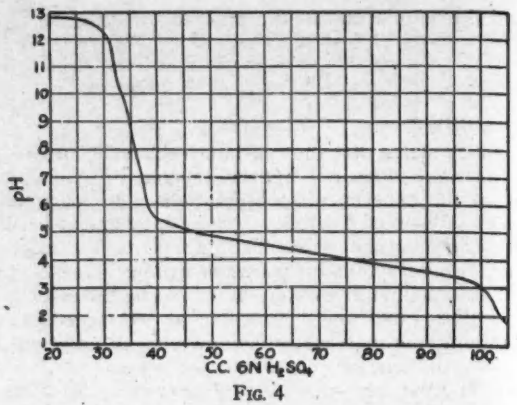


FIG. 4

identical, the small difference being due to the free ethylenediamine present. Actually the 3:1 compound is blue whereas the 2:1 compound is violet, however, in dilute solution, the 3:1 complex reverts to the 2:1 complex with liberation of the amine and change in color. On the other hand if the two compounds are dissolved in 30% ethylenediamine, instead of a violet solution a blue solution is formed and identical transmissions for the two are obtained, thus showing that both compounds in solution have a molar ratio of amine to copper of 3:1. At constant copper concentration it was observed that below an amine concentration of approximately 30% the 2:1 compound begins to form, presumably due to solvation with the substitution of water for diamine. Hence, it is possible to conclude from these experiments that the 2:1 compound exists in dilute aqueous solution as the di-aquo ion $Cu\ en_2(H_2O)_2^{++}$, and upon the progressive addition of concentrated ethylenediamine the water is replaced by amine to give the complex ion, $(Cu\ en_2en)^{++}$, in agreement with the work of Cole et al. Rosenblatt *(12)* has shown that the water in the above complex can be substituted by ammonia thus:

$$[Cu\ en_2(H_2O)_2]^{++} + NH_3 \rightleftarrows [Cu\ en_2(H_2O)(NH_3)]^{++} \quad (5)$$

and also

$$[Cu(NH_3)_4]^{++} + NH_3 \rightleftarrows [Cu(NH_3)_5]^{++} \quad (6)$$

Stackelberg and Freybhold *(13)* have also deduced the existence of copper-ammonia complexes with molar ratios of ammonia to copper of 2 to 5 by a study of these solutions with the polarograph.

The compound containing copper and diamine in the ratio of unity is peculiar. It apparently does not exist as the simple ion, $(Cu\ en)^{++}$ or $(Cu\ en(H_2O)_4)^{++}$. On the addition of barium hydroxide to 1 mole of the sulphate of this compound there is precipitated a compound which contains 1 mole of barium, 2 moles of sulphate and 1 mole of copper. Repeating this same experiment with the 2:1 and 3:1 compound, it was found that barium sulphate was the only reaction product. This would indicate the following:

$$(Cu\ en_2)SO_4 + Ba(OH)_2 \rightleftarrows (Cu\ en_2)(OH)_2 + BaSO_4 \quad (7)$$

$$[Cu\ en_3]\ [Cu(SO_4)_2] + Ba(OH)_2 \rightleftarrows (Cu\ en_2)(OH)_2 + Ba[Cu(SO_4)_2] \quad (8)$$

The existence of the dimeric compound given above was also reported by Chattaway and Drew *(2)* who determined its presence by the various chloro-platinates that could be formed. From the analysis of the 1:1 compound it was impossible to decide whether it contained 2, 4, or 6 molecules of water.

Electrometric Studies

A series of potentiometric titrations were made using a Leeds and Northrup precision pH meter

with shielded extended leads and the customary glass and calomel electrodes. These titration curves are given in Figs. 3 and 4. Figure 3 shows a portion of the curves obtained in the titration of an ethylenediamine solution saturated with copper hydroxide and the same solution when an excess of ethylenediamine is present. The final break in the curves shows that the decomposition of the complex is complete at a pH of approximately 3.5 (not shown). The curve where an excess of ethylenediamine is present shows two additional steps which represent the neutralization of the free ethylenediamine. It may be mentioned here that these steps are not noticeable when only a small excess of ethylenediamine is present in dilute solution.

The lower curve in Fig. 3 represents the electrometric titration of the diamine saturated with copper hydroxide. The total volume of acid required to completely neutralize and decompose the complex amounted to 57.5 ml. of 1 *N* H_2SO_4. The amount of acid required to neutralize the hydroxyl groups (first break) amounted to 18.5 ml. In the upper curve the amount of diamine added was equivalent to 18.0 ml. of 1 *N* H_2SO_4, and the total acid required for the complete neutralization of the complex was 75.5 ml. which checks with the original titration. The two additional steps in upper curve each required 7.75 ml. of acid. Hence, 2.5 ml. acid, equivalent to ethylenediamine is unaccounted for; however, this would be accounted for if the ratio of the total copper present to diamine is less than 1 : 2 and the equilibrium is represented by:

$$2Cu\ en_3(OH)_2 \rightleftarrows (Cu\ en_3)(Cu(OH)_4) + 2en \qquad (9)$$

If this is the case, the ratio of diamine to copper present as determined from these curves was found to be approximately 1.80. The determination of copper by precipitation with salicylaldoxime according to Ephraim *(4)*, and the determination of the amine by difference, gives a ratio of 1.89 for the same solution. From numerous tests on cupriethylenediamine solutions saturated with copper, it was finally decided that the ratio of total copper to diamine is dependent on concentration.

Figure 4 shows a potentiometric titration of a concentrated solution of copper saturated diamine approximately 1 *M* in copper, titrated with 6 *N* sulphuric acid. The two small breaks at the right are presumably due to the free ethylenediamine present in saturated solutions.

The Nature of the Reaction With Cellulose

An equilibrium as represented by Equation (9) would explain the fact that an increase in conductivity takes place on the addition of the diamine, and on the addition of a strong base, such as sodium or potassium hydroxide, the equilibrium is shifted to the right; hence, more cupric hydroxide could be put in solution according to experimental observations.

This type of an equilibrium would also explain the dissolution of cellulose to form a complex compound in the form Cu-en-cellulose thus:

$$[Cu\ en_2]\ [Cu(OH)_4] + 2C_6H_{10}O_5 \rightleftarrows [Cu\ en_2]\ [Cu(C_6H_9O_5)_2] + 4H_2O \qquad (10)$$

where the ratio of copper, cellulose, and en in the complex is 1 : 1 : 1.

It also explains the fact that cellulose would be precipitated if an excess of diamine were added. The addition of sodium hydroxide would thus favor the formation of the compound [Cu en_2] [$Cu(OH)_4$] and thus increase the solubility of cellulose. If, however, a large excess of sodium hydroxide is added the cellulose is precipitated as the sodium salt, the cupriethylenediamine salt being represented in equation (10) in accordance with the observations of Traube, Hess, and Jolley.

In the cuprammonium hydroxide system, as was pointed out by Jolley, the molar ratio of ammonia to cupric hydroxide in saturated solutions depends on the concentration of ammonia, but is never much below 50, and this, of course, is far in excess of the simple stoichiometric proportions demanded by the complex, $Cu(NH_3)_4(OH)_2$. According to Hess's theory when cellulose is dissolved in this cuprammonium solvent 8 moles of ammonia should be set free. However, both Jolley and Berl and Innes *(1)* found it impossible to detect this free ammonia by two different means. The reason for this may have been due to the fact that either, their methods of analysis were not sensitive enough, or that no ammonia was set free.

It appears very strange that such great apparent differences should exist as to the mechanism of the reaction between cellulose and cupriethylenediamine on one hand, and cuprammonium hydroxide on the other. These two complex solvents form similar types of compounds in the absence of cellulose as shown by Cole and the present authors; hence, it is peculiar that their reaction mechanisms with cellulose should be so different. There is, however, one important feature that apparently has been completely overlooked by all previous investigators in this field. This is the reaction between cellulose and cupriethylenediamine solutions where the ratio of diamine to copper is very high, approaching that of the cuprammonium system.

It was found that cellulose could be dissolved in a solution 0.25 *M* in copper and containing approximately 600 grams per liter of ethylenediamine. The molar ratio of diamine to copper in this system is approximately 40. Dilution with water of such a solution containing cellulose causes its ultimate precipitation just as it does in the corresponding cuprammonium solution. This fact brings harmony into the two systems. It is conceivable that if low ratios of ammonia to copper could exist a similar reaction to that taking place in copper saturated ethylenediamine solutions would occur.

Stamm *(14)* has shown from ultracentrifuge experiments that the normal type of cuprammonium solvent contains colloidally dispersed cupric hydroxide. This thus affords us a mechanism for the dissolution of cellulose in cuprammonium and cupriethylenediamine solutions containing a large excess of the diamine. The proposed mechanism is given as follows:

$$2C_6H_{10}O_5 + (Cu\ en_2{\cdot}en)(OH)_2 \rightleftarrows (Cu\ en_2)(C_6H_9O_5)_2 + 2H_2O \qquad (11)$$

$$(Cu\ en_2)(C_6H_9O_5)_2 + Cu(OH)_2 \rightleftarrows [Cu\ en_2]\ [(C_6H_9O_5)_2Cu] + 2H_2O \qquad (12)$$

A similar mechanism for the cuprammonium system can be given where the active solvent is $Cu(NH_3)_6(OH)_2$ as proposed by Cole et al.

The above equations representing the mechanism for the dissolution of cellulose in cupriethylenediamine are similar to those proposed by Jolley and Hess for the dissolution of cellulose in sodium hydroxide, i.e., the formation of a salt and the precipitation as the sodium salt of a cupri-cellulose anion on the addition of cupric hydroxide, the soluble cupri-tri-ethy-

lenediamine salt being represented as the reaction product of equation (12) above.

The addition of the diamine or of ammonia in the corresponding system would not affect the equilibria as shown above in the sense of cellulose precipitation. The increase in concentration of diamine in the cupriethylenediamine-cellulose system probably increases the amount of $(Cu\ en_3)^{++}$ ion according to similar observations by Stackelberg and Freyhold. This would increase the solvent power of the solution. When cellulose is dissolved in such a solvent the cupric hydroxide bound in the complex can be replaced by the dissolution of additional cupric hydroxide, thus allowing a further quantity of cellulose to be dissolved in agreement with experimental fact.

Conclusions

A study of the experimental results and discussion presented in this paper, together with a knowledge of previous experimental investigations appear to justify the following conclusions:

1. The dissolution of cellulose in cupriamine bases is due to the formation of a complex copper-cellulose anion.

2. The active component responsible for the dissolution of cellulose in copper-saturated cupriethylenediamine is most probably the dimeric compound, $[Cu\ en_2]\ [Cu(OH)_4]$, or some similar solvated compound.

3. The active components responsible for the dissolution of cellulose in the copper-diamine solution containing a large excess of ethylenediamine may be $(Cu\ en_3)\ (OH)_2$ and $Cu(OH)_2$. The similarity of the blue color of the two active diamine solvents indicates, at least superficially, that some form of cupric hydroxide may be responsible for the cellulose-complex formation, and hence its dissolution. This is in accord with the nature of the compounds proposed. The blue-violet cupri-di-ethylene-diamine compound is not a solvent for cellulose.

4. The ratio of total diamine to total copper in saturated solutions is probably less than 2:1 which indicates that both the cupri-mono-amine and cupri-di-amine are present. This ratio and the equilibrium between the mono- and di- compounds are dependent on concentration, and until more refined methods of analyses are made available the exact nature of these ratios and equilibrium constants cannot be accurately determined.

5. The similarity between the cupriethylenediamine system and the cuprammonium system has been brought to light and in view of the experimental results obtained, the two systems may be considered similar in all respects. The differences that previously existed were due to the fact that only a partial investigation had been made. The only difference in the two systems is the difference in the stability of the two complexes. According to Cole and his coworkers, the diamine forms a much more stable complex due to the bidentate linkage.

6. Copper appears to retain a coordination number of 4 in its complex formations, however, it appears probable that an additional two groups may be added to the complex in the form of loosely bound constituents, similar to water of crystallization, giving copper an apparent coordination number of 6.

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Nek A.S.T.M. Compilation on Paper

The publication for the first time in this compact booklet of all the standards of the American Society for Testing Materials on paper and paper products is indicative of the intensive work A.S.T.M. Committee D-6 on Paper Products has carried out. Although there were some previously existing specifications and tests, particularly in the field of electrical insulating materials, this relatively new committee has developed a large number of tests to determine the properties of paper and paper products.

Of the six specifications included three are used for electrical insulation, one is for waterproof paper for curing concrete, and two pertain to quicklime for paper manufacture. Most of the 144 pages of the book are devoted to the 30 test methods which include procedures for the following: alkali staining, ash content, casein, compression testing, folding endurance, grease resistance, moisture, opacity, resistance to passage of air, surface wettability, tearing resistance, thickness, and basic weight.

In much of its work Committee D-6 has cooperated closely with TAPPI.

Copies of this 144-page publication in heavy paper cover can be obtained from A.S.T.M. Headquarters, 260 S. Broad street, Philadelphia 2, Pa., at $1.35 per copy.

Chlorine Institute Meets

The Chlorine Institute, Inc., held its annual meeting and directors' meetings last week at the Chemists' Club, New York, N. Y. The following directors were elected for two years: George M. Dunning, Wyandotte Chemicals Corporation; F. W. Fraley, Jr., Diamond Alkali Company; R. W. Hooker, Hooker Electrochemical Company; S. W. Jacobs, Niagara Alkali Company; E. C. Speiden, Isco Chemical Division of Innis, Speiden & Co.

The hold-over directors are: Thomas Coyle, E. I. du Pont de Nemours & Co., Inc., Electrochemicals Department; W. I. Galliher, Pittsburgh Plate Glass Company; Louis Neuberg, Westvaco Chlorine Products Corporation; E. E. Routh, The Mathieson Alkali Works, Inc.; B. P. Steele, Pennsylvania Salt Manufacturing Company; Eli Winkler, Southern Alkali Corporation.

At a directors' Meeting following the Annual Meeting, the officers shown below were elected for the year 1944:

S. W. Jacobs, president; E. C. Speiden, vice president; Robert T. Baldwin, secretary and treasurer.

Index, Technical Section, Paper Trade Journal Volume 117, July to December, 1943

Prepared by Clarence J. West, Chairman, Committee on Abstracts and Bibliography, TAPPI

The page numbers in the following index refer to the continuous pagination of the *Technical Section* and not the pagination of the individual numbers of the PAPER TRADE JOURNAL. Author entries are printed in capitals.

To Facilitate Reference

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More Waste Paper is Needed

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, Feb. 2, 1944—Full cooperation of the paper and paper board industry with local waste paper collecting agencies is essential if the paper board mills are to be kept in operation, Willard L. Davis, Assistant Director of the War Production Board Paperboard Division, said today.

Waste paper now is No. 1 salvage material and, although collections were reported as picking up, Frank Block of the United States Waste Paper Company, told members of the Container Board and Fiber Box Industry Advisory Committee their continued backing was needed if the industry was to meet the two-million-ton goal required every three months.

Waste paper is an essential material in the manufacture of many fiber shipping containers, and comprises as high as 99% of the substance of some boxes. Contact with local newspapers was also urged, as their publicity has coordinated the mill requirements and the local salvage collections. Despite being handicapped somewhat through labor and transportation problems, local voluntary pick-up services have done well so far, Mr. Block said, adding that the campaign must be kept going as the mills require waste paper supplies regularly.

Suggested revisions of standards for light-weight kraft board, eliminating calibre requirements, have been approved by the various segments of the industry and now meet the freight and railroad requirements, it was explained by Mr. Davis, who added that a saving of approximately 30,000 tons of linerboard a year might result.

Paper Group Elects Officers

CHICAGO, Ill., January 31, 1944—The Professional Paper Group of Chicago has elected the following officers:—president, Harold R. Alley, Tested Papers of America, Inc.; vice-president, A. E. Montgomery, Ross Engineering Company; secretary, V. V. Vallandighan, Kelco Company; treasurer, Arnold McAneny, Bradner Smith & Co.

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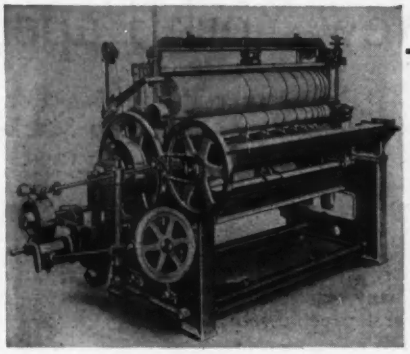

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New York Paper and Pulp Market Review

Paper Production For 1943 Is Computed At 17,036,273 Tons — Paper and Pulp Markets Strong — Pulpwood Receipts Up With 14,000,000 Cords the Goal For 1944—Waste Paper Demand Heavy.

Office of the PAPER TRADE JOURNAL,
Wednesday, February 2, 1944.

Strong wholesale demand and a rather tighter supply situation in kraft lines, is reported by some of many manufacturers' representatives, jobbers, and general paper merchants during the current week.

The index of general business activity for the week ended January 22, rose to 148.2, from 146.8 for the previous week, compared with 133.3 for the corresponding week last year. The index of paper board production was 142.2, compared with 152.0 for the previous week, and with 142.6 for the corresponding week last year.

Over-all production of paper for 1943 according to the Bureau of Census was 17,036,273 tons, compared with 16,888,636 tons in 1942, and with 17,762,365 tons in 1941, which was an all-time record.

Paper production for the week ended January 22 was estimated at 89.2%, compared with 87.9% for 1943, with 105.0% for 1942, with 87.4% for 1941, and with 91.2% for the corresponding week for 1940.

Paper board production for the week ended January 22 was 93.0%, compared with 88.0% for 1943, with 101.0% for 1942, with 78.0% for 1941, and with 75.0% for the corresponding week for 1940.

Some of the higher types and grades of writing paper may have to be abandoned, according to Rex W. Hovey of the WPB, some weights reduced and more waste paper and filler used, to meet the first 1944 quarter requirements of 222,534 tons.

Wood Pulp

Mill receipts of pulpwood have improved somewhat. Receipts in the Northeast, according to the Pulpwood Consuming Industries, were 105,000 cords in December, compared with 87,000 cords in November. Receipts of Appalachian pulpwood totaled 175,000 cords, while southern mills reported 571,000 cords. The national goal for 1944 is 14,000,000 cords, compared with receipts of 13,096,000 cords in 1943, and with 16,712,000 cords in 1942.

Rags

Demand for new cotton cuttings is active at this date in all grades. Prices are firm to strong at ceilings.

Trading in old cotton rags continues active, with some quarters reporting heavy mill buying in the roofing grades. Prices are strong at ceilings.

Old Rope and Bagging

No important change in the old rope market has been reported this week. Mill demand is active and continues to absorb all available Manila rope at ceiling prices.

Trading in scrap bagging continues rather slow. Volume is light. Prices continue largely of a nominal nature.

Old Waste Paper

The paper stock market continues strong, with some mills still reported in urgent need of immediate supplies to continue operations. With favorable weather like the present, collections are expected to be substantially higher than normally received at this time of the year, which has been one of seasonal decline in the past. Prices on all grades are firm.

Twine

Demand for twine is active for such grades as are obtainable for trade purposes. The wartime grade of mixed fibers is "pretty poor stuff", according to reports received from several quarters. Kraft paper twines seem to be a fair substitute for some grades of unobtainable fiber twines, but the tying characteristics are not particularly good, reports state. Prices in this market are firm.

P. J. White to Head Waste Dealers

Paul Joseph White, president of the Great Eastern Packing and Paper Stock Corporation of New York City and Long Island, has by unanimous vote of the Nominating Committee of the National Association of Waste Material Dealers, Inc., been tendered the nomination for the presidency of that organization.

Mr. Write has, for a number of years, been president of the Waste Paper Institute and for the past two years has also been chairman of the Waste Paper Trade Committee. At present he is a consultant to the Salvage Division of the War Production Board.

While it has been customary since inception of the organization over thirty years ago to select presidents from the various divisions making up the organization, Mr. White is the first man nominated whose major operations in the waste material field are waste paper.

Forum on WPB Policy and Program

The American Paper and Pulp Association will hold an industry forum on War Production Board policy and program in the Jade Room of Waldorf-Astoria on Wednesday, February 16, 1944. James L. Madden, assistant director of Paper Division, in charge of pulpwood, WPB, will speak on pulpwood. David Graham, director, Office of Pulp Allocation, WPB, will speak on pulp and Rex W. Hovey, director of Paper Division, WPB, will speak on paper. Since the course of business in 1944 will be more directly affected by War Production Board program and policy than by any other single factor, this meeting will be an important feature of Convention Week.

Chicago Group to Meet

The Chicago Professional Paper Group will meet at the Medinah Club, 505 N. Michigan Blvd., on Monday evening, February 7. A color film "Packaging—A Public Service" will be shown. This will be followed by a panel discussion on Waterproof Adhesives for Cartons and Containers led by Major James d'A. Clark. Members of the panel will include George W. Gray, Ralph Findley, S. F. Thune, Sam Sculler, J. E. Killinger, Jordan Bauer, S. W. Campbell and M. Warford.

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MISCELLANEOUS MARKETS

Office of the PAPER TRADE JOURNAL.
Wednesday, February 2, 1944.

BLANC FIXE—Prices on blanc fixe continue to conform to prevailing quotations. Demand is reported fair. The pulp is quoted at $40 per ton, in barrels, at works. The powder is quoted at $60 per ton, f.o.b. works.

BLEACHING POWDER—Demand is reported active with the supply situation satisfactory. Quotations are unchanged. Bleaching powder is currently quoted at from $2.50 to $3.10 per 100 pounds. All prices in drums, car lots, fo.b. works.

CASEIN—OPA maximum prices on processed acid-precipitated casein are as follows: 10,000 pounds or more, 24 cents per pound; 2,000 pounds, 24½ cents per pound; less than 2,000 pounds, 24¾ per pound, f.o.b. source.

CAUSTIC SODA—Demand heavy. Shipping situation reported a little improved this week. Prices continue unchanged. Solid caustic soda is currently quoted at $2.30 per 100 pounds. The flake and ground are currently quoted at $2.70 per 100 pounds. All prices in drums, car lots, f.o.b. works.

CHINA CLAY—Current demand is reported moderate on many grades of china clay. Quotations continue to conform to prevailing prices. Domestic filler clay is quoted at from $7.50 to $15 per ton; coating clay is currently quoted at from $12 to $22 per ton, at mines. Imported china clay is currently quoted at from $13 to $25 per long ton, ship side.

CHLORINE—Demand active, with all allocation requirements met. Prices continue unchanged. Chlorine is currently quoted at $1.75 per 100 pounds, in single-unit tank cars, f.o.b. works.

ROSIN—The rosin market reports higher prices on some grades this week. "G" gum rosin is currently quoted at $4.13 per 100 pounds, in barrels, at Savannah. "FF" rosin is currently quoted at $4.11 per 100 pounds, in barrels, at New York. Seventy per cent gum rosin size is currently quoted at $4.39 per 100 pounds, f.o.b. works.

SALT CAKE—Prices on salt cake continue to be reported unchanged. Demand is moderate for the current week. Domestic salt cake is currently quoted at $15 per ton, in bulk. Chrome cake is currently quoted at $16 per ton. All quoted prices in car lots, f.o.b. shipping point.

SODA ASH—The supply situation in soda ash continues tight under a very heavy demand. Slight gain in shipments. Some imports have arrived. Prices continue to conform to prevailing levels. Quotations on soda ash in car lots, per 100 pounds, are as follows: in bulk, $.90; in paper bags, $1.05; and in barrels, $1.35.

STARCH—Cash corn available for trade consumption continues limited and market is still tight on corn and corn products. Prices unchanged on starch. Pearl is quoted at $3.10 per 100 pounds. Powdered starch is quoted at $3.20 per 100 pounds. All prices in bags, car lots f.o.b. Chicago.

SULPHATE OF ALUMINA—Demand moderate. Supply situation is reported satisfactory at this date. Prices of the commercial grades are currently quoted at from $1.15 to $1.25 per 100 pounds. The iron free is currently quoted at $2.35 per 100 pounds. All prices in bags, car lots, f.o.b. works.

SULPHUR—Current consumption of sulphur continues heavy with no change in the market situation. Quotations on annual contracts are unchanged at $16 per long ton, f.o.b. mines. The current price on contracts at Gulf Ports continues unchanged at $17.50 per long ton.

MARKET QUOTATIONS

All market quotations, excepting those otherwise designated as official OPA maximum prices, are based on the manufacturers' price level as of October 1-15, 1941; maximum wholesale prices are based on the merchants' maximum prices for stipulated quantities at a quoted price to all customers of a like class, as shown by the merchant's sales records of goods delivered during March, 1942. A merchant's price list in effect in March 1942, showing quotations of actual shipments, will establish the current maximum prices.

Paper

(Delivered New York)

News, per ton—

Roll, contract...	*$58.00	@	—
Sheets	64.00	"	—

* OPA Maximum Price.

Kraft—per cwt.—Carload Quantities Zone A, f.o.b. Mill

Superstandard Wrapping	*$5.25	@	—
No. 1 Wrapping...	*5.00	"	—
Standard Wrapping	*4.75	"	—
Standard Bag.....	*4.375	"	—

* OPA Manufacturers' Prices.

Tissues—Per Ream—Carlots

White No. 1.....	1.12½	"	—
White No. 1 M. G.	1.10	"	—
White No. 1½....	1.00	"	—
White No. 2.....	.90	"	—
Anti-Tarnish M.F..	1.20	"	—
Colored	—	"	—
Kraft	.95	"	—
Manila	.90	"	—

Toilet—1 M. Sheets—Per Case

Unbleached	4.25	"	—
Bleached	5.70	"	—
Unbl. Toilet, 1 M.	4.16	"	—
Bleached Toilet...	5.70	"	—

Paper Towels, Per Case—

Unbleached, Jr.....	2.20	"	—
Bleached, Jr.....	3.20	"	—

Manila—per cwt.—C. l. f. a.

No. 1 Jute.....11.25		@	—
No. 1 Manila Wrapping, 35 lb.....	6.00	"	6.25
No. 2 Manila Wrapping, 35 lb.....	5.75	"	6.00

Boards, per ton—

News *48.00		@	—
Chip *48.00		"	—
Sgl. Mia. Lt. Chip*	60.00	"	—
White Pat. Coated*	75.00	"	—
Kraft Liners 50 lb.*	63.00	"	—
Binders Boards....	84.00	"	116.00

* OPA Base Prices per 10 tons. Less than 10 tons but over 3 tons, add $2.50; three tons or less, add $5; regular 35-39 basis, add $5.; basis 40-49, add $2.50; basis 91-100, add $2.50; basis 101-120, add $5.

The following are representative of distributors' resale prices:

Rag Content Bonds and Ledgers—White, Assorted Items, Delivered in Zone 1:

	Bonds		Ledgers
100% Rag Ext. No. 1	$39.10@$46.00		$40.25@$47.25
100% Rag	32.20 " 37.75		33.35 " 39.25
85% Rag	.... "		29.90 " 35.00
75% Rag	23.00 " 27.00		24.15 " 28.25
65% Rag	.... "		22.80 " 27.75
50% Rag	18.70 " 22.75		19.90 " 24.25
25% Rag	16.40 " 20.00		17.55 " 21.50

Colors at $1.00 cwt. extra.

Sulphite Bonds and Ledgers—White, Assorted Items. Delivered in Zone 1:

	Bonds	Ledgers
No. 1..	$10.55@$12.75	$11.70@$14.25
No. 2..	9.65 " 11.75	10.80 " 13.25
No. 3..	9.20 " 11.25	10.35 " 12.50
No. 4..	8.90 " 10.75	10.05 " 12.25

Colors $1.00 cwt. extra.

Free Sheet Book Papers—White, Cased Paper. Delivered in Zone 1:

No. 1 Glossy Coated...	$13.65@$13.8
No. 2 Glossy Coated...	12.40 " 14.0
No. 3 Glossy Coated...	11.60 " 13.2
No. 4 Glossy Coated...	11.15 " 12.7
No. 1 Antique (watermarked)	10.25 " 11.7
No. 2 Offset.....	9.60 " 11.0
A Grade E. F.....	9.35 " 10.7
A Grade S. & S. C....	9.60 " 11.0
B Grade E. F.....	8.85 " 10.2
B Grade S. & S. C....	9.10 " 10.5
C Grade E. F.....	8.55 " 9.7
C Grade S. & S. C....	8.80 " 10.0
D Grade E. F.....	8.25 " 9.5
D Grade S. & S. C....	8.50 " 9.7

Ivory & India at $.50 cwt. extra.

Wood Pulp

OPA Maximum Prices and Canadian Manufacturers Prices, Less Freight, Not Exceeding OPA Allowances.

Bl. Softwood Sulphite.....	$76.00
Unbl. Softwood Sulphite.	65.00@ 66.00
Bl. Hardwood Sulphite.....	73.50
Unbl. Hardwood Sulphite....	63.50
Bl. Mitscherlich.....	81.00
Unbl. Mitscherlich ...	72.00@ 82.00
N. Bleached Sulphate.....	86.00
S. Bleached Sulphate.....	79.00
N. Semi-Bleached Sulphate...	82.00
S. Semi-Bleached Sulphate....	75.00
N. Unbl. Sulphate.....	73.00
S. Unbl. Sulphate.....	63.50
Bl. Soda	66.00
Unbl. Soda	62.00
Groundwood	46.00

Transportation Allowances

Applying to Producers of Wet Wood Pulp.

	Below 50% Air Dry Weight
Northeast	$13.50
Lake Central	13.50
Southern	16.00
West Coast (in area).....	10.50
West Coast (out area).....	16.50

	50%-80% Air Dry Weight
Northeast	$11.50
Lake Central	11.50
Southern	14.00
West Coast (in area).....	9.50
West Coast (out area).....	15.50

Applying to Producers of Dry Wood Pulp.

	Above 80% Air Dry Weight
Northeast	$8.50
Lake Central	8.50
Southern	11.00
West Coast (in area).....	7.50
West Coast (out area).....	13.50

Should freight charges actually exceed these allowances, the difference may be added to the maximum prices

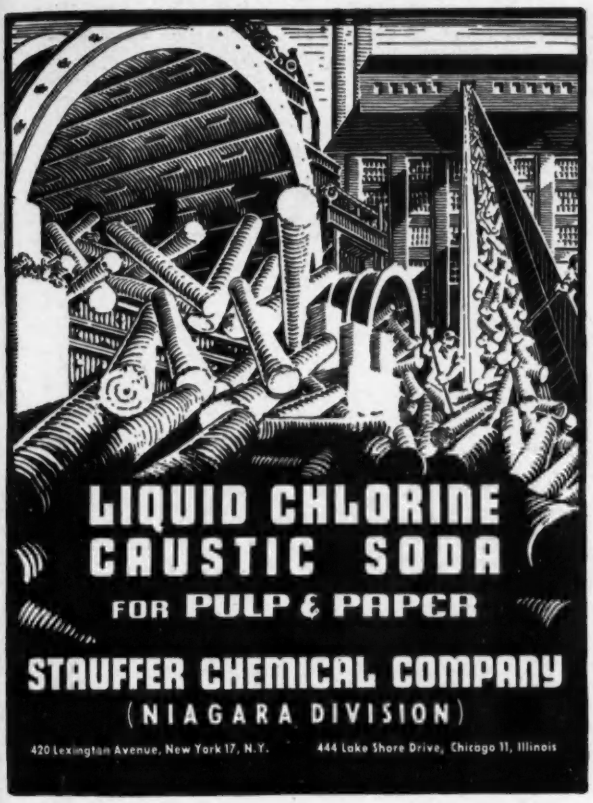
Domestic Rags

New Rags

(Prices to Mill f. o. b. N. Y.)

Shirt Cuttings— New White, No. 1..	6.50	@	7.25*
Silesias No. 1.....	—	"	5.75*
New Unbleached...	6.75	"	7.50*
Blue Overall.....	—	"	5.50*
Fancy	—	"	3.50*
Washables	—	"	3.00*
Bleached Khaki Cuttings	—	"	4.25*
Unbleached Khaki Cuttings	—	"	3.50*

* OPA Maximum Prices.



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How to Get Rid of *Four* Pulp-Mill Headaches !

Adjusting or building up sulfite liquor concentrations ...producing pulp when your acid plant is down for repairs...improving brightness and permanence of bleached kraft... protecting wet-machine felts when handling bleached stock (by using SO_2 as an antichlor) ...add up to four pulp-mill headaches you can get rid of quickly by using Ansul Liquid Sulfur Dioxide.

ANSUL* Sulfur Dioxide

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Supplied in tank cars, ton drums and 150-lb. cylinders. 99.9% pure.

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HELICAL GEARS
WORM GEARS
CENTRIFUGAL BLOWERS
AND COMPRESSORS

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CENTRIFUGAL PUMPS
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THE CORROSION RESISTANT ALLOY
CAST • ROLLED • FABRICATED
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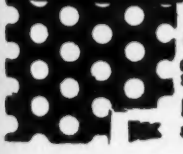

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Copper, Bronze, Steel, Stainless Steel and other metals, Rust-proofed.

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Offices in Principal Cities

Appleton Wires are Good wires

APPLETON WIRE WORKS, INC. APPLETON, WIS.

Old Rags

White, No. 1—		
Repacked	*3.80	—
Miscellaneous	*3.20	—
White, No. 2—		
Repacked	*2.90	—
Miscellaneous	*2.65	—
Third and Blues—		
Repacked	*2.20	—
Miscellaneous	*1.80	—
Roofing Rags—		
No. 1	*1.55	—
No. 2	*1.45	—
No. 3 (bagging)	*1.35	—
No. 4	*1.35	—
No. 5A	*1.35	—
Old Manila Rope	5.75	—

OPA Maximum Prices.

Foreign Rags

All Prices nominal

New Rags

New Dark Cuttings	2.25	2.40
New Mixed Cuttings	2.00	2.20
New Light Silesias	5.50	5.75
Light Flannelettes	5.50	5.75
New White Cuttings	7.00	7.50
New Light Oxfords	4.00	4.50
New Light Prints	3.00	3.25

Old Rags

No. 1 White Linens	7.50	8.50
No. 2 White Linens	6.50	7.50
No. 3 White Linens	4.50	—
No. 4 White Linens	2.25	3.25
No. 1 White Cotton	4.25	4.75
No. 2 White Cotton	3.25	3.75
No. 3 White Cotton	2.50	3.00
No. 4 White Cotton	1.90	2.20
Extra Light Prints	2.00	2.40
Ord. Light Prints	1.75	2.15
Med. Light Prints	1.55	1.95
Dutch Blue Cottons	2.25	2.50
French Blue Linens	3.00	—
Checks and Blues	2.00	—
Linsey Garments	1.90	2.00
Dark Cottons	1.50	1.60
Old Shopperies	1.30	1.45
New Shopperies	1.45	1.50
French Blues	2.25	2.50

BAGGING

(Prices to Mill, f. o. b. N. Y.)

Gunny No. 1—		
Foreign	Nominal	
Domestic	4.25	4.35
Wool Tares, light	4.25	4.50
Wool Tares heavy	4.50	5.00
Bright Bagging	4.50	4.85
Manila Rope—		
Foreign	—	—
Domestic	*5.75	—
Jute Threads	5.50	—
No. 1 Sisal Strings	*4.00	—
Mixed Strings	2.00	—

* OPA Maximum Price.

Old Waste Papers

(F. o. b. New York)

OPA Maximum Prices

No. 1 Hard White Envelope Cuts, one cut	3.37½	—
No. 1 Hard White Envelope Cuts	3.12½	—
No. 1 Hard White Shavings, unruled	2.87½	—
No. 1 Hard White Shavings, ruled	2.50	—
Soft White Shavings, one cut	2.87½	—
No. 1 Soft White Shavings	2.50	—
Soft White Shavings, Misc.	2.15	—
No. 1 Fly Leaf Shavings	1.67½	—
No. 2 Fly Leaf Shavings	1.12½	—
No. 1 Groundwood Fly Leaf Shavings	1.25	—
No. 2 Mixed Groundwood Fly Leaf Shavings	.90	—
Mixed Colored Shavings	.75	—
Mixed Groundwood Colored Shavings	.90	—
Overissue Magazines	1.67½	—
No. 1 Heavy Books & Magazines	1.67½	—
Mixed Books	.85	—
No. 1 White Ledger	2.17½	—
No. 2 Mixed Ledger, colored	1.87½	—
New Manila Envelope Cuttings, one cut	2.87½	—
New Manila Envelope Cuttings	2.65	—
Extra Manilas	1.85	—
Mixed Kraft, Env. & Bag Cuttings	2.75	—
Kraft Envelope Cuttings	3.25	—
Triple Sorted, No. 1 Brown Soft Kraft	2.50	—
New 100% Kraft Corrugated Cuttings	2.25	—
No. 1 Assorted Old Kraft	1.75	—
New Jute Corrugated Cuttings	.90	—
Old 100% Kraft Corrugated Containers	1.75	—
Old Corrugated Containers	1.15	—
Box Board Cuttings	.72½	—
White Blank News	1.65	—
Overissue News	.85	—
No. 1 News	.75	—
No. 1 Mixed Paper	.70	—
Old Corrugated Containers	.82½	—
Mill Wrappers	.85	—

Twines

All Prices Nominal

(F. o. b. Mill)

(Soft Fiber)

Coarse Polished—		
India	.21	—
White Hemp	.21	—
Fine Polished—		
Fine India	.26	—
Unpolished—		
Box	.17½	—
Paper Makers	.17	—
Tube Rope	.19	—
Wall Paper	.20½	—
Wrapping	.23	—
Soft Fiber Rope	.19	—
Cotton	.25	—

(Hard Fiber)

Medium Java	.18	—
Mex. Sisal	.16	—
Manila		—

PHILADELPHIA

Domestic Rags (New)

(Price to Mill, f. o. b. Phila.)

Shirt Cuttings—		
New White No. 1	.07½	.07½
New White No. 2	.04½	.05
Light Silesias	.04½	.04¾
Silesias, No. 1	.04	.04¼
Black Silesias, soft	.03¾	.04
New Unbleached	.07¼	.07½
Washable Prints	.03¾	.03½
Washable No. 1	.02	.02¼
Blue Overall	.04½	.05½
Cottons—According to grades—		
Washable shredding	—	.01¾
Fancy Percales	.03¼	.03½
New Black Soft	.02¾	.03
New Dark Seconds	1.75	2.00
Khaki Cuttings—		
No. 1 O. D.	.03	.03¼
No. 2 Mixed	.02¼	.02½
Corduroy	.01¾	.02¼
New Canvas	.04¾	.05¼
New Black Mixed	—	.02½

Domestic Rags (Old)

White No. 1—Repacked	3.80	—
White No. 2—Repacked	2.90	—
Miscellaneous No. 1	3.20	—
Miscellaneous No. 2	2.65	—
Third and Blues—		
Miscellaneous	1.80	—
Repacked	2.20	—
Black Stockings— (Export)	Nominal	
Roofing Stock—		
Foreign No. 1	Nominal	
Domestic No. 1	1.55	—
Domestic No. 2	1.45	—
Roofing Bagging	1.35	—
Old Manila Rope	5.75	—

Bagging

(F. o. b. Phila.)

Gunny No. 1—		
Foreign	Nominal	
Domestic	3.00	3.50
Sisal Rope	3.75	—
Mixed	1.00	1.50
Scrap—		
No. 1	3.25	3.50
No. 2	1.75	1.80
Wool Tares	4.00	4.25
No. 1 New Light Burlap	3.00	4.00
New Burlap Cuttings	3.75	4.00

Old Papers

(F. o. b. Phila)

OPA Maximum Prices

No. 1 Hard White Envelope Cuts, one cut	3.37½	—
No. 1 Hard White Shavings, unruled	2.87½	—
Soft White Shavings, one cut	2.50	—
White Blank News	1.65	—
Soft White Shavings, Misc.	2.13	—
No. 1 White Ledger	2.17½	—
No. 2 Ledger, colored	1.87½	—
No. 1 Heavy Books & Magazines	1.67½	—
Overissue Magazines	1.67½	—
New Manila Envelope Cuttings	2.65	—
No. 1 Assorted Old Kraft	1.75	—
No. 1 Mixed Paper	.70	—
Box Board Cuttings	.72½	—
Kraft Corrugated Cuttings	2.25	—
Old Corrugated Containers	1.15	—
Overissue News	.85	—
No. 1 News	1.00	—

BOSTON

Old Papers

(F. o. b. Boston)

OPA Maximum Prices

No. 1 Hard White Shavings, unruled	2.87½	—
No. 1 Hard White Shavings, ruled	2.50	—
Soft White Shavings, Misc.	2.15	—
No. 1 Fly Leaf Shavings	1.67½	—
No. 2 Fly Leaf Shavings	1.12½	—
No. 1 Groundwood Fly Leaf Shavings	1.25	—
No. 2 Groundwood Fly Leaf Shavings	.90	—
Mixed Colored Shavings	.75	—
New Manila Envelope Cuts, one cut	2.87½	—
Hard White Envelope Cuts, one cut	3.37½	—
Triple Sorted No. 1 Brown Soft Kraft	2.50	—
Mixed Kraft Env. & Bag Cuttings	2.75	—
Kraft Envelope Cuttings	3.25	—
No. 1 Heavy Books & Magazines	1.67½	—
New Manila Envelope Cuts, one cut	2.87½	—
New Manila Envelope Cuttings	2.65	—
White Blank News	1.65	—
No. 1 Assorted Old Kraft	1.75	—
No. 1 Mixed Paper	.70	—
Overissue News	.85	—
Box Board Cuttings	.72½	—
New Corrugated Cuttings, Kraft	2.25	—
Old 100% Kraft Corrugated Containers	1.75	—
Old Corrugated Containers	1.15	—
Jute Corrugated Cuttings	1.07½	—

Bagging

(F. o. b. Boston)

Gunny Bagging—		
Foreign	(nominal)	
Domestic	2.50	2.75
Sisal Rope No. 1	*4.75	—
Sisal Rope No. 2	*4.25	—
Mixed Rope	1.35	1.50
Transmission Rope—		
Foreign	(nominal)	
Domestic	2.75	3.00
Manila Rope—		
Foreign	(nominal)	
Domestic	5.75	—
Soft Jute Rope	5.25	—
Jute Carpet Threads	3.00	3.50
Bleachery Burlap	8.50	9.00
Scrap Burlap—		
Foreign	(nominal)	
Domestic	3.25	3.50
Wool Tares—		
Foreign	(nominal)	
Domestic	4.25	—
Aust. Wool Pouches	3.75	4.00
New Burlap Cuttings	4.75	5.00
Heavy Baling Bagging	4.00	4.25
Paper Mill Bagging	2.50	3.00
No. 2 Bagging	1.35	—

* OPA Maximum Price.

Domestic Rags (New)

(F. o. b. Boston)

Shirt Cuttings—		
New Light Prints	.04½	.04¾
Fancy Percales	.04¼	.05
New White No 1.	.06¾	.07
New Light Flannelettes	.05¾	.06
Canton Flannels, Bleached	.06	.06¼
Underwear Cutters, Bleached	.06¼	.06¾
Underwear Cutters, Unbleached	.05¼	.06
Silesias No. 1	.06	.06¼
New Black Silesias	.03	.03½
Red Cotton Cuttings	.03½	.04
Soft Unbleached	.06½	.06¾
Blue Cheviots	.05½	.06
Fancy	.02¾	—
Washable	.02¾	—
Khaki Cuttings	.02¾	.03
O. D. Khaki	.03½	.03¾
Corduroy	.03¼	.03½
New Canvas	.06¼	.06¾
B. V. D. Cuttings	.06¾	.06¾

Domestic Rags (Old)

(F. o. b. Boston)

White No. 1—Repacked	3.80	—
Miscellaneous	3.20	—
White No. 2—Miscellaneous	2.65	—
Twos and Blues, Repacked	2.20	—
Old Blue Overalls	2.25	2.50
Thirds and Blues, Repacked	2.20	—
Miscellaneous	1.80	—
Black Stockings	3.50	4.00
Roofing Stock—		
No. 1	1.55	—
No. 2	1.45	—
No. 3	1.35	—
No. 4	1.35	—
No. 5, Quality A	1.35	—
Quality B	1.20	—
Quality C	.95	—
Old Manila Rope	5.75	—

* OPA Maximum Prices.

Foreign Rags

(F. o. b Boston)

Canvas	(nominal)
Dark Cottons	(nominal)
Dutch Blues	(nominal)
New Checks and Blues	(nominal)
Old Fustians	(nominal)
Old Linsey Garments	(nominal)
New Silesias	(nominal)

CHICAGO

Waste Paper

(F. o. b. Chicago)

OPA Maximum Prices.

Shavings—		
No. 1 Hard White Envelope Cuts, one cut	1.37½	—
No. 1 Hard White Shavings, unruled	2.87½	—
No. 1 Soft White Shavings	2.50	—
No. 1 White Ledger	2.17½	—
No. 1 Heavy Books & Magazines	1.67½	—
White Blank News	1.65	—
Mixed Kraft Env. & Bag Cuttings	2.75	—
No. 1 Assorted Old Kraft	1.75	—
Overissue News	.85	—
No. 1 News	.75	—
No. 1 Mixed Paper	.70	—
No. 1 Roofing Rags	1.55	—
No. 1 Roofing Bags	1.45	—